Site: Carrier
Break: 3.4
Other: V.1

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY SAMPLING PLAN FOR THE COLLIERVILLE SITE COLLIERVILLE, TENNESSEE REVISION: C

Prepared for

CARRIER CORPORATION
SYRACUSE, NEW YORK

Prepared by

ENVIRONMENTAL AND SAFETY DESIGNS, INC
MEMPHIS, TENNESSEE

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STANDARD OPERATING PROCEDURES: GLASSWARE PREPARATION

Overview

The glassware preparation area helps insure the superior quality of the clients' data by insuring that all glassware is clean, and contaminant-free. Clean glassware is critical to the effective operation for the laboratories, and for this reason, adherence to the following preparation procedures is very important.

Glassware Preparation SOP 1.1:

Preventing Laboratory Contamination

Preventing laboratory contamination is a basic concern. The following provides helpful tips on how to make glassware preparation more productive and efficient. It is important to keep in mind at all times the obligation of the department and the laboratory to our customers is the production of high-quality data.

1. Keep all brushes clean, and hung on the hooks provided.
2. Keep the dishwasher door closed at all times.
3. Do not cap liter bottles with wet caps.
4. Remove the paper liner to make sure caps are dry and free from all contamination.
5. Thoroughly brush all glassware.
6. Use proper brushes for each type of glassware.
7. No solvent is to be used on the glassware preparation area.
8. Cover all clean liter bottles with foil or caps and liners.
9. Store all laboratory glassware in cabinets or storage racks as soon as possible.
10. Change wash water with each new cart of glassware. **Do not** prepare two or more carts of glassware in the same water.
11. Wash the sink thoroughly before beginning to prepare laboratory glassware.

Do the following before glassware is distributed to the various laboratories.

1. Check all glassware removed from the oven.
   A. Check for stains.

B. Check for breakage.

2. If the glassware is not clean, do not forward to the labs.

3. When removing glassware from the oven, use Zetex gloves at all times.

4. Do not allow your hands to touch the inside of the glassware.

<u>**Glassware Preparation SOP 1.2:**</u>

Preparing Plastic Caps, Teflon Discs, and Teflon-Lined Septa

Wash all new and recycled caps, discs and septa with hot, soapy water and thoroughly rinse them in hot, tap water. Then rinse them with water from the laboratory's pure-water system. Following the rinse, place them on a clean, metal tray or in a metal basket. Put them in the Precision oven at 105°C for a period of 1 hour. Following a cooling period in a contaminant-free area, place discs inside plastic caps and screw them down onto 1-liter glass bottles. Place septa inside plastic caps (teflon side down) and screw them down into 40-ml glass vials.

<u>**Glassware Preparation SOP 1.3**</u>:

Preparing SampleSaver Glassware

The SampleSaver contains 5 different kinds of glassware. The procedures for preparing this glassware follow. Even though they all go into one container, they are all prepared differently. They are not prepared with other laboratory glassware because their preparation procedures are different.

<u>Organics</u> - 1-liter glass bottles

NOTE: New liter bottles are washed in the dishwasher, rinsed, drained and dried. Recycled liter bottles are washed in hot, soapy water, rinsed, drained, and dried.

1. Wash in dishwasher or
    a. Wash in hot, soapy water and
    b. Rinse well with tap water.
2. Rinse twice with deionized water.
3. Invert and drain.
4. Bake at 450-500°F for one hour.

5. Wash teflon caps in the same manner

   (as in SOP (1.4).

Metals and Mercury - 500 ml Plastic Bottles (Metals)

1. Wash in dishwasher or hand wash with

   hot, soapy water.

2. Rinse three times with tap water.

3. Rinse three times with deionized water.

4. Invert on counter-top for drying.

5. Wash caps per SOP 1.4.

Volatiles - 40 ml glass bottles (Cyanide and Phenols)

1. Wash in dishwasher.

2. Rinse twice with deionized water.

3. Place in oven at 500°F for 1 hour. Remove

   to volatiles area to cool. Cap immediately

   after they cool enough to touch.

4. Caps and septums should be washed and dried

   per SOP 1.4.

Glassware Quality Control Check

Quality Assurance monitors the SampleSaver glassware to ensure that the glassware is not contaminated. This monitoring process is conducted in the following ways for each type of glassware.

Quality Control of VOA Bottles (40 ml glass bottles): Checked for Volatile Compounds Contamination

After the bottles are taken our of the oven, they are allowed to cool in the "Unapproved" storage cabinet in the volatile prep area. After they are cool, they are capped and out into boxes (72 per box), which are called batches. The boxes are stored in the cabinet marked "Unapproved."

The SampleSaver Custodian completes the "VOA Glassware Prep Batch Check" (See Example 1 at the end of these SOPs), assigns a number to the bottle (numbers are consecutive and ascending), and removes one bottle from the batch. The Custodian then moves the box to the storage cabinet marked "Under Evaluation" and attaches a copy of the Batch Check sheet to the box. He/She also notes on the Batch Check Sheet that the results of the analysis are to be sent to Quality Assurance.

He/She then delivers the bottle to be tested to the Manager of the Volatiles Laboratory. In this way, there is a record of the testing, the bottle has a unique number, the number is associated with the batch of bottles with which it is processed, and the results are forwarded directly to Quality Assurance. Quality Assurance maintains a file containing copies of all Batch Checksheets, including which batches have passed and which have not. This file serves as the ongoing documentation of this process.

The manager of the Volatiles Laboratory tests the bottle for volatile compounds and forward the results to Quality Assurance.

The Quality Assurance Specialist determines if the bottle's analysis indicates any contamination. If the analysis detects any volatile compound at one half the detection limit for that compound, another VOA bottle from the same batch is tested. If the second bottle is also found to be contaminated, the QA Specialist notifies the Supervisor of Sample Preparation, and the entire batch is reprocessed. If the analysis indicates no contamination is present, the Supervisor of Sample Preparation moves the batch to a storage cabinet labelled "Approved," which indicates that the bottles are free if contamination and can be included in the SampleSavers shipped to clients. The QA Specialist advises the Director of Quality Assurance if there are persistent or frequent problems with the glassware preparation process. When VOAs are needed, they are taken from the storage cabinet marked "Approved."

Quality Control of Liter Bottles: Checked for Organic Compounds Contamination

Fifty, liter bottles are furnaced together and are called a batch. After the bottles are taken out of the oven, they are allowed to cool in the "Unapproved" storage cabinet located in the Glass Prep area. One bottle out of each batch is tested for organic compounds contamination.

The Supervisor of the Sample Preparation Laboratory completes a "SV Glassware Prep Batch Check" (See Example 2 at the end of this SOP). which indicates that the test results are forwarded to Quality Assurance, (numbers are consecutive and ascending), and removes one bottle from the batch. The Supervisor then moves the batch to the storage cabinet in the Sample Prep area marked "Under Evaluation" and attaches a copy of the Batch Check to the batch. He/she also notes in writing on the Worksheet that the results of the analysis are to be sent to Quality Assurance.

In this way, there is a record of the testing, the bottle has a unique testing number, this number is associated with the batch of bottles with which it was processed, and the results are forwarded directly to Quality Assurance. The supervisor of the Sample Preparation Laboratory keeps a notebook containing copies of all Batch Check sheets, including which batches have passed and which have not. This notebook is called the Quality Control For SampleSaver and serves as the ongoing documentation of this process.

The Supervisor of the Sample Preparation Laboratory fills the bottle with distilled, deionized water, assigns it a CompuChem number, and indicates in the comments section that this bottle is used as a QC sample for a SampleSaver check. The water is then extracted as an acid and base neutral blank and analyzed by GC/MS. A portion of the B/N fraction is exchanged to Hexane and analyzed by GC. The results are quantitated and forwarded to QA.

The Quality Assurance Specialist determines if the bottle's analysis indicates any contamination. If the analysis detects any extraneous peaks (peaks other than the surrogates), another liter bottle from the same batch is tested. If the second bottle is also found to be contaminated, the QA specialist notifies the Supervisor of Sample Preparation, and the entire batch is reprocessed. If the analysis indicates no contamination is present, the Supervisor of Sample Preparation is notified and the batch is moved to a storage cabinet labeled "Approved", located in the Sample Receiving area, which indicates the bottles are free of contamination and can be included in the SampleSavers shipped to clients. The QA Specialist advises the Director of Quality Assurance if there are persistent or frequent problems with the glassware preparation process.

When liter bottles are needed, they are taken from the storage cabinet marked "Approved."

Quality Control of Plastic Bottles (500 ml: Checked for Inorganics Contamination (Metals)

Fifty, plastic bottles are dried together and are called a batch. After the bottles are taken out of the oven, they are put in the "Unapproved" storage area located in the Glassware Prep area. One out of each batch is tested for metals contamination.

When bottles are needed, the Supervisor of the Sample Preparation Laboratory completes and "Order Form For Test Samples" (see Example 3 at the end of these SOPs). checks "glassware check" as the reason for initiating the test (which also indicates that the test results are forwarded to Quality Assurance), assigns a number to the bottle (numbers are consecutive and ascending), and removes one bottle from the batch. The Supervisor then moves the batch to the storage cabinet marked "Under Evaluation" in Sample Receiving and attaches a copy of the Worksheet to the batch. He/she also notes in writing on the Worksheet that the results of the analysis are to be sent to Quality Assurance.

In this way, there is a record of the testing, the bottle has a unique testing number, this number is associated with the batch of bottles with which it was processes, and the results are forwarded directly to Quality Assurance. The supervisor of the Sample Preparation Laboratory keeps a notebook containing copies of all forms, including which batches have passed and which have not. This notebook is called the Quality Control for SampleSaver and serves as the ongoing documentation of this process.

The Supervisor of the Sample Preparation Laboratory fills the bottle with distilled/deionized water, assigns it a CompuChem number, and indicates in the comments section that this bottle is used as a QC sample for a SampleSaver check. He/she takes the bottle to the inorganics Laboratory, where it is analyzed for all metals, the results are quantitated, and forwarded to QA.

The Quality Assurance Specialist determines if the bottle's analysis indicates any contamination. If the analysis indicates contamination another bottle from the same batch is tested. If the second bottle is also found to be contaminated, the QA Specialist notifies the Supervisor of Sample Preparation, and the entire batch is reprocessed. If the analysis indicates no contamination is present, the Supervisor of Sample

VOA GLASSWARE PREP BATCH CHECK

EXAMPLE 1

CASE # ____________ DUE DATE ____________

VOA
GC/MS WORKSHEET

COMPUCHEM# ________________________

J ___ J3 ___ D ___ (:1)

J2 ___ J4 ___ D2 ___ (:1)

LIQUID

___ BL ___ BS ___ SS ___ DU

Sample Prep Code ___000
Instrument Code ___201
Compound List ___040
Surrogate Std ___399
Internal Std ___040

================================

Library Searches Required: ___ 0 ___ 5 ___ 10 ___ 15 ___ 20 ___ ______

Library Search ONLY Required: ___ 5 ___ 10 ___ 15 ___ 20 ___ 30 ___ ______

================================

GC/MS ANALYSIS SEE ATTACHED SIS ___

Amount Purged: ___ 5 mls or ___ Dilution (____________ ul/5000ul Sparged)
Internal Std Volume Added ____________ ul Surrogate Std Volume Added ____________ ul
BFB Filename ____________ Disk ( )
Blank Filename ____________ Disk ( )
Standard Filename ____________ Disk ( )
Sample Filename ____________ Disk ( )

ANALYST(S) Injection ____________ Work-up ____________

================================

GC/MS REVIEW

Entry Codes OK, JS, SM, SL, SH, JA, DA

CONDITION
CODE

Non-Entry Codes IM, IL, IH, SW, CT, CS, PC, NR, IF, LA, DI, CO, RN, DW, SI, SF, UP, BB, OT, VC, FO, SM, NS

DISPOSITION: ______ Complete

______ Reinject Neat

______ Dilute (:1)

Extraneous Peak Search Results:
# of Peaks Found: ____________

Quality Assurance Notice(s):
Notices Required: ____________
COMMENTS:

GC/MS Review ____________ Date ___/___/___ Auditor ____________ Date ___/___/___

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REPORT INTEGRATION Total # of Injections: ____________

Final Reportable Package: ________________________

================================

QA COMMENTS

Initials ________ Date ___/___/___

================================

FINAL REVIEW Initials ________ Date ___/___/___

WS079 (2/85)

SV GLASSWARE PREP BATCH CHECK

EXAMPLE 2

DUE DATE:

SEMI-VOLATILE
GC/MS WORKSHEET   COMPUCHEM#:

J[ ] R[ ] D[ ] (:1)

J2[ ] R2[ ] D2[ ] (:1)

LOW LEVEL LIQUID
Deliverable Code 069

Sample Prep Code --- 056
Instrument Code --- 254
Compound List --- 170
Surrogate Std --- 392
Internal Std --- 035 (added by GC/MS)

SAS: EPA#:

GC/ANALYSIS

Volumes mixed: BN ______________ ul Acid ______________ ul
Internal Standard Volume Added ______________ ul
Mixed Sample Volume Injected ______________ ul
Date of Sample Bottle Analyzed ____/____/____
DFTPP Filename ______________ Disk ( )
Standard Filename ______________ Disk ( )
Sample Filename ______________ Disk ( )

ANALYST(S): Injection ______________ Work-up ______________

GC.MS REVIEW ________

CONDITION CODE ________ ________

Entry Codes OK, EA, JA, ES, AL, AH, PL, PH, FL, JS, FH, NL, NH, YL, SL, SH, SM, YM

Non-Entry Codes IM, IL, IH, SW, CT, CS, PC, OT, NS, ED, IF, LA, DI, CO, RN, DW, DA

Disposition: [ ] Complete

Extraneous Peak Search Results:
# of Peaks Found: ________

[ ] Reinjection required

[ ] Reextraction required

Quality Assurance Notice(s):
Notices Required ______

[ ] Dilute (:1)

COMMENTS:

[ ] Reinject Heat

[ ] Send to QA

GC/MS Review ______ Date____/____/____ Auditor ______________ Date____/____/____

REPORT INTEGRATION   Total # of Injections: ______________

Final Reportable Package(s) ______________/______________

QA COMMENTS:

FINAL REVIEW: Initials ________ Date ____/____/____

EXAMPLE 3

ORDER FORM FOR TEST SAMPLES

DATE: ______________________________

REQUESTED BY: __________________ APPROVAL: ____________________

DELIVER FINAL RESULTS TO: ______________________________________

REASON FOR INITIATING TEST(S):

1. EXTRACTOR PROFICIENCY ( )
2. GLASSWARE CHECK ( )
3. ISOLATE CONTAMINATION ( )
4. METHOD VALIDATION ( )
5. PERFORMANCE EVALUATION ( )
6. PROCEDURAL DEVELOPMENT ( )
7. QUARTERLY LABORATORY PROFICIENCY TEST ( )
8. SOLVENT TEST ( )
9. OTHER ( ) __________________

SPECIAL INSTRUCTION:

1. ATTACHED ( )
2. NONE ( )

SAMPLE I.D.	ANALYSIS CODE(S)	PREP CODE(S)	TURNAROUND	COMPUCHEM #

Preparation is notified and the batch is moved to a storage cabinet labeled "Approved", which indicates that the bottles are free of contamination and can be included in the SampleSavers shipped to clients. The QA Specialist advises the Director of Quality Assurance if there are persistent or frequent problems with the glassware preparation process.

When bottles are needed for cyanide and phenols, they are taken from the storage cabinet marked "Approved."

Glassware Preparation SOP 1.4:

Preparing Glassware for the Sample Preparation Laboratory's

> **NOTE:** Volumetric glassware (Examples: pipets, flasks) is not annealed.

Glassware used in the Sample Preparation Laboratory should be prepared in the following manner.

1. Wash with hot, soapy water.
2. Rinse well with tap water.
3. Rinse well with deionized water.
4. Annealed at 500°C for 6 hours.

Glassware Preparation SOP 1.5:

Preparing Glassware for the Inorganics (Metals) Laboratory

1. Wash with hot, soapy water.
2. Rinse well with tap water.
3. Rinse well with deionized water.
4. Invert glassware and place on a clean Inorganics Station (Metals) cart for drying, and distribute to the lab.

Glassware Preparation SOP 1.6:

Cleaning Procedure for Sampling Equipment

1. Wash with non-phosphate laboratory-type detergent and tap water.
2. Rinse with tap water.
3. Rinse with distilled/deionized water.
4. Rinse with 10% acidic (HC1 or HNO_3) solution (only for metals analysis).
5. Rinse with distilled/deionized water.
6. Rinse with pesticide-grade acetone (only for organics analysis).
7. Complete air dry.
8. Rinse with organic-free reagent water.

Glassware Preparation SOP 1.7:

Cleaning Procedure For the Zero Headspace Extractor (ZHE) And Associated Glassware (Beakers, Flasks, Graduated Cylinders, Syringes)

Glassware used in the preparation of extraction fluid, 1.ON Sodium Hydroxide, the syringes used to collect the ZHE sample, and the beakers plus the graduated cylinders should be prepared in the following manner:

1. Wash with hot, soapy water.
2. Rinse well with tap water.
3. Rinse well with deionized water.
4. Place in oven at 500oC for 1 hour. Remove to the volatiles area to cool.

The Zero Headspace Extractors are dissembled in the Glassware Preparation Area and the waste is dumped into the hazardous waste containers located in the Environmental Extractions Lab. The different components of the ZHE are washed separately (vitron O rings, pistons, cylinders, etc...). The ZHEs should be prepared in the following manner:

1. Wash with hot, soapy water.
2. Rinse well with tap water.
3. Rinse well with deionized water.
4. Place in oven at 120°C for 1 hour. Remove to the volatiles area to cool.

   NOTE: After the ZHE has cooled, and the piston and the bottom portion inserted, the following rinsing steps are done to ensure that the ZHEs contain no contaminants prior to loading the sample.

1. Pour 200ml of Methanol into the cylinder, assemble the top of the ZHE without the filter but with the screens, and pressurize the ZHE, opening the valve to discard the Methanol.
2. Remove the top of the ZHE, add 200ml of sparged distilled deionized water, replace the top with screens and without filter, pressurize the ZHE, opening the valve to discard the warer. The ZHE is ready to be used. .

Initial Documentation for SOPs :

Including Designated Personnel Responsibilities

The Director of Quality Assurance and the Supervisor,Sample Preparation Laboratory, have read and approved this group of Standard Operating Procedures (Glassware Preparation, numbers 1.1 through 1.7).

SOPs approved by: ______________________ Date: ____________

Director of Quality Assurance

SOPs approved by: ______________________________ Date: ______________

Supervisor, Sample Preparation Laboratory

These procedures describe how tasks are performed in the Glassware Preparation area. If a question arises concerning the proper procedure to follow for an activity in this area, these SOPs should be consulted to resolve the question. Also, these SOPs are a valuable source of material for training purposes.

After the manager of this area believes the person responsible for these tasks has mastered these SOPs, both the manager and the employee should sign and date this form, assuring that these SOPs are understood and will be followed in the daily operations of CompuChem Laboratories. Please forward a copy of this signed and dated form to Quality Assurance.

Employee's name: ______________________________ Date: ______________

Employee's title: ______________________________

Employee's name: ______________________________ Date: ______________

Employee's title: ______________________________

Employee's name: ______________________________ Date: ______________

Employee's title: ______________________________

Manager's name: ______________________________ Date: ______________

Manager's title: ______________________________ Date: ______________

Quality Assurance SOP 3.1:

Initial Documentation for SOP: Including Designated Personnel

Responsibilities

Each set of SOPs (Standard Operating Procedures) is accompanied by an initial Documentation Form. This form is located at the end of each separate set of SOPs. There may be several forms for a single section. This form is used to assure that personnel understand the tasks and responsibilities of their positions. All employees should review the SOPs for their area, date, and sign the form, indicating that they understand the operations they are accountable for.

An initial Documentation Form is filled out by the manager of the area and the person being trained. On each form there is a line for the employee to sign, which verifies that this person understands the SOPs he or she will be held accountable for, and there is a line for the employee's manager to sign, which verifies that the manager assures that the employee does understand the SOPs covered by the form.

After the manager and the employee sign and date the form, a copy is sent to Quality Assurance. The Director of Quality Assurance will review and sign the initial Documentation Form. The Communications Specialist will send a copy to the manager, keep a copy, and send a copy to the Human Resources Department (to become a part of the employee's permanent record).

Quality Assurance SOP 3.2:

Revision of Standard Operating Procedures

SOPs are updated as changes are made in procedures. The working SOP, maintained in the area to which it applies, is the copy on which changes should be made (by hand) at the time the change is initiated. All changes should be made by drawing a single line through the section changed (while not obscuring the previous wording) and clearly writing the correct wording. Please write legibly. If the change is extensive, please attach the additional material on a separate piece of paper.

Once the correction is completed, the writer should submit a copy of the revised SOP for a technical review to the area's manager (unless the writer is the manager). When the SOP is finalized, the writer and the manager, using the form Revising or Creating SOPs (located on the next page), should both sign and date the fact that the SOP is complete and correct. If the manager wrote the corrections, he or she should sign as both the writer and the reviewer.

The area's manager should then forward a copy of the signed and dated form and a copy of the revised SOP to a Quality Assurance representative. Quality Assurance reviews all SOPs to be certain that they comply with good laboratory practices, governing regulations, and Company policy.

Documentation Form for:

Revising or Creting Standard Operating Procedures (SOPs): Including Designated Personnel Responsibilities

_______ Revised Procedure _______ New Procedure _______ Procedure Attached

_______________________________________ _______________

Procedure Area, Title, and SOP Number Effective Date

_______________________________________ _______________

Procedure Prepared By Date

_______________________________________ _______________

Procedure Read, Understood, and Approved By Appropriate Laboratory Station Manager Date

_______________________________________ _______________

Procedure Read, Understood, and Approved by Quality Assurance Representative Date

This procedure(s) meets the requirements as set forth in the following References for Approved Methods:

____

____

____

____

These procedures describe how tasks are performed in this specific area. If a question arises concerning the proper procedure to follow for an activity in this area, these SOPs should be consulted to resolve the question. Also, these SOPs are a valuable source of material for training purposes.

After the manager of this area believes the person responsible for these tasks has mastered these SOPs, both the manager and the employee should sign and date this form, assuring that these SOPs are understood and will be followed in the daily operations of CompuChem Laboratories. Please forward a copy of this revised or created SOP and a completed form to Quality Assurance.

Employee's name: ______________________________ Date: ______________

Employee's title: ______________________________

Employee's name: ______________________________ Date: ______________

Employee's title: ______________________________

Manager's name: ______________________________ Date: ______________

Manager's title: ______________________________

Quality Assurance will then update all SOP manuals to be consistent with laboratory practice and forward the revised SOP to the area's manager, who should replace the old SOP with the revised SOP.

Current SOPs are maintained in the Quality Assurance office.

SOP Revision Documentation

Quality Assurance SOP 3.3:

Creation of Standard Operating Procedures

A Standard Operating Procedure (SOP) is written by someone who is familiar with the process being documented. The SOP should contain a description of the procedure to be followed to successfully perform the operation. The SOP should be written to conform with the format of other SOPs in the area and be such that a trained person can successfully complete the operation with a minimum of difficulty.

The writer should submit the SOP for a technical review to the area's manager (unless the writer is the manager). When the SOP is finalized, the writer and the manager, using the Revising or Creating SOPs form (located on the precious page), should both sign and date the fact that the SOP is correct and complete. If the manager wrote the SOP, he or she should sign as the writer and the reviewer.

The area's manager should then forward a copy of the signed and dated form and a copy of the new SOP to the Director of Quality Assurance. Quality Assurance reviews all SOPs to be certain that they comply with good laboratory practice, governing regulations, and Company policy.

Current SOPs are maintained in the Quality Assurance Office. Quality Assurance will then update all SOP manuals and forward the new SOP to the area's manager, who then adds the new SOP to the section's SOPs.

Carrier
3.2

1.0 INTRODUCTION

The following Sampling Plan has been prepared to implement a Remedial Investigation and Feasibility Study (RI/FS) of the Collierville Site located in Collierville, Tennessee. The Site was proposed for the National Priorities List on Update #7, June 24, 1988 but has not been finalized to date. The Site was also placed on the State of Tennessee List of Hazardous Substance sites in March, 1987. (Prior Site investigations were conducted under State of Tennessee oversight.) This investigation will be conducted by Environmental & Safety Designs, Inc. (EnSafe), Memphis, Tennessee, in association with Dames & Moore (D&M), Cincinnati, Ohio. The Sampling Plan has been prepared in accordance with the Administrative Consent Order entered into with the Carrier Corporation by the United States Environmental Protection Agency (US EPA), Region IV. The order was signed on 29 September 1989 and is final.

The mutual goal of EPA and Carrier under this Consent Order is to accomplish a Remedial Investigation and Feasibility Study for the Collierville Site. In detail, objectives are as follows: (A) to determine fully the nature and extent of any threat to the public health or welfare or the environment caused by the release or threatened release of hazardous substances, pollutants, or contaminants at or from the Site; and (B) to evaluate alternatives for the appropriate extent of any remedial action to prevent or mitigate the migration or the release or threatened release of hazardous substances, pollutions, or contaminants at and from the Site.

1.1 Site Logistics

To effectively conduct the RI/FS for the Collierville Site field logistics will be incorporated to facilitate the investigation.

Subcontractors

All subcontractors hired to aid in the Site investigation will be familiar with the contents of the Work Plan, Sampling Plan, and Health and Safety Plan. All work will be performed in accordance with the approved plans. Mobilization of field equipment to the site will occur within thirty (30) days of US EPA approval of the aforementioned plans, as projected in the Work Plan schedule.

Field Office

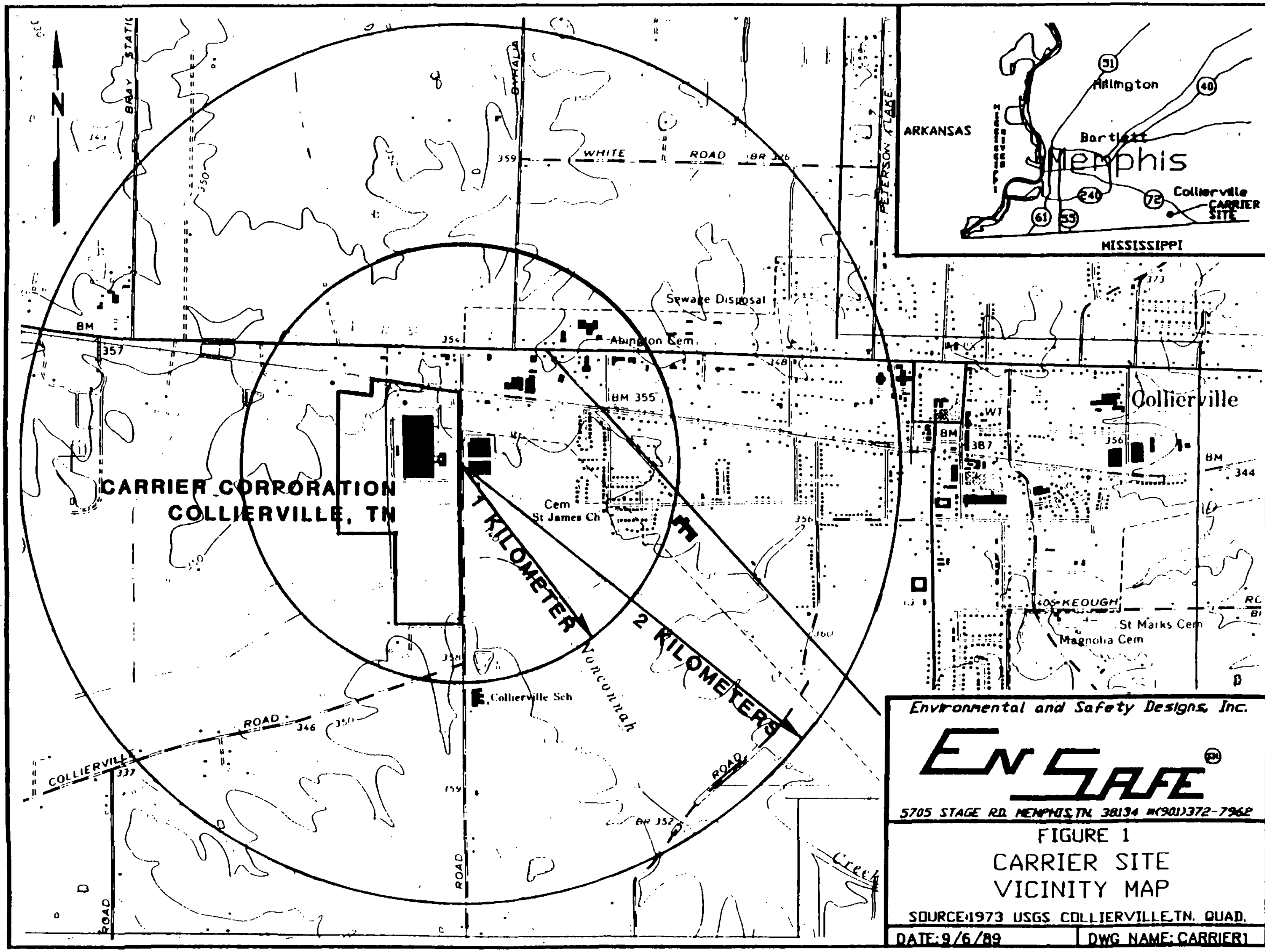
A field office will be set up on the Collierville Site. This office will be a small trailer to be used for equipment storage, sample processing, and site control. The office will also be used to store decontamination and health and safety support equipment. The field office will be equipped with a refrigerator for sample preservation, a telephone for site communications and emergencies, and a restroom facility.

1.2 Site Background

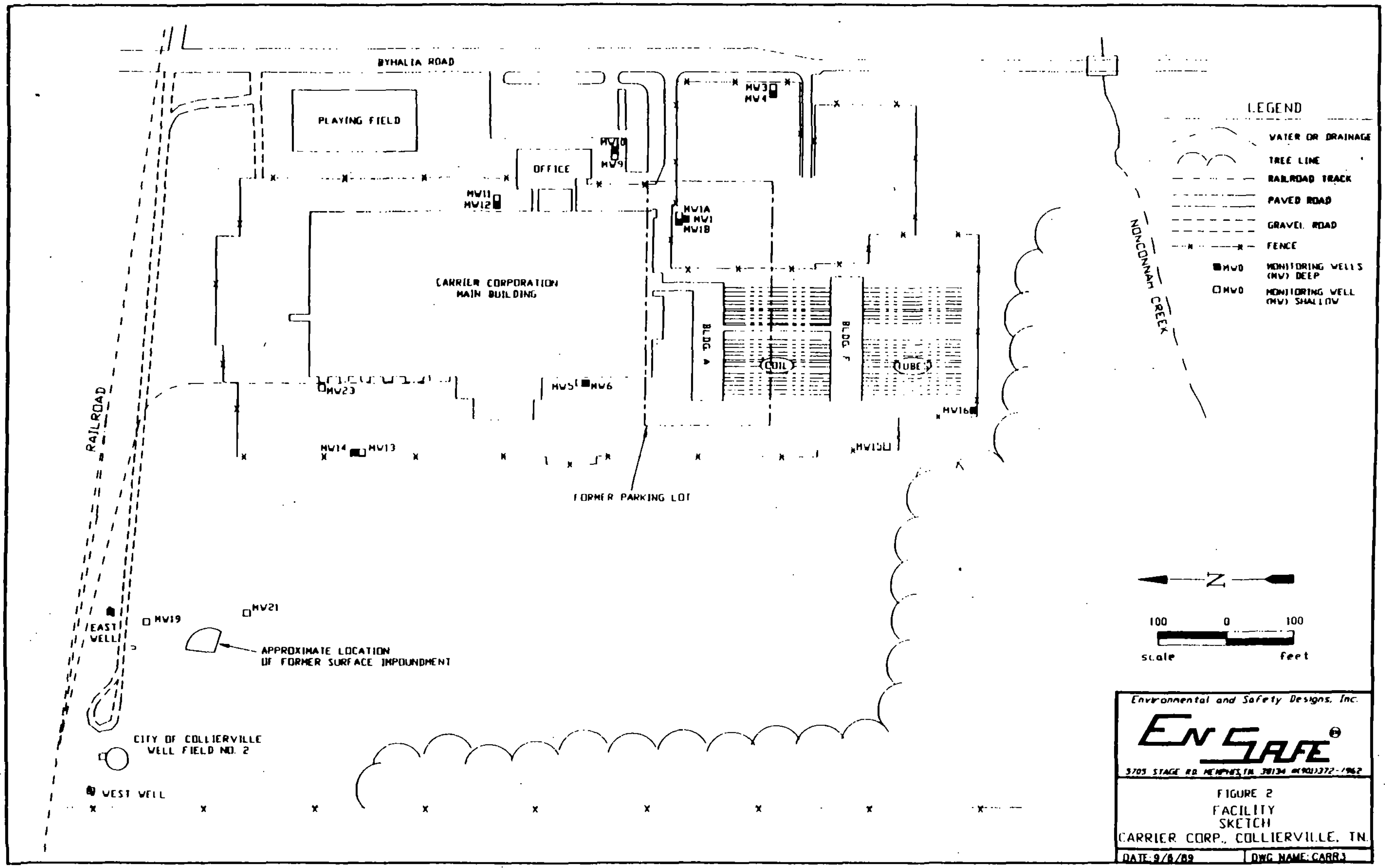
The Collierville Site consists of approximately 145 acres southwest of the intersection of Highway 57 and Byhalia Road in Collierville, Tennessee. Figure 1 is a vicinity map for the facility. The property was farmland until 1967 when it became industrial with the construction of the present manufacturing facility (then called Day & Night Company). Original topographic data, as well as original subsurface conditions, are available from Site investigations performed in 1966 and 1967 to determine foundation construction conditions. The facility has been expanded several times in the interim. In particular, the area south and west of the manufacturing facility has undergone changes in use and topography since 1979. Figure 2 is a sketch of the property showing locations of current structures and existing monitoring wells. Original topographic and drainage pattern data for the property have been obtained.

A recent topographic map of the property may be found as Attachment A of this Sampling Plan. Several changes have occurred on the Site since this map was prepared. It will be updated as part of the RI/FS.

Trichloroethylene (TCE) has been released to the Site, and has been detected in soil samples and in ground water monitoring wells at the Site.



CARRIER CORPORATION
COLLIERVILLE, TN
1 KILOMETER
2 KILOMETERS
WHITE ROAD
Sewage Disposal
Abingdon Cem.
BM 355
Collierville
WT
BM
387
356
BM
344
Cem
St James Ch
KEOUGH
St Marks Cem
Magnolia Cem
Collierville Sch
Nonconnah
Creek
ROAD
COLLIERVILLE
ROAD
BRAY STATION
BYHALIA
PETERSON LAKE
ARKANSAS
MISSISSIPPI
Millington
Bartlett
Memphis
Collierville
CARRIER SITE
Environmental and Safety Designs, Inc.
EnSafe
5705 STAGE RD. MEMPHIS, TN. 38134 #(901)372-7962
FIGURE 1
CARRIER SITE
VICINITY MAP
SOURCE: 1973 USGS COLLIERVILLE, TN. QUAD.
DATE: 9/6/89
DWG NAME: CARRIER1


BYHALIA ROAD
PLAYING FIELD
OFFICE
MW10
MW9
MW3
MW4
MW11
MW12
MW1A
MW1
MW1B
CARRIER CORPORATION
MAIN BUILDING
BLDG. A
BLDG. F
COIL
TUBE
MW23
MW5
MW6
MW16
MW14
MW13
MW15
FORMER PARKING LOT
RAILROAD
NONCONNAH CREEK
LEGEND
WATER OR DRAINAGE
TREE LINE
RAILROAD TRACK
PAVED ROAD
GRAVEL ROAD
FENCE
MW0 MONITORING WELLS (MW) DEEP
MW0 MONITORING WELL (MW) SHALLOW
N
100
0
100
scale
feet
EAST WELL
MW19
MW21
APPROXIMATE LOCATION
OF FORMER SURFACE IMPOUNDMENT
CITY OF COLLIERVILLE
WELL FIELD NO. 2
WEST WELL
Environmental and Safety Designs, Inc.
EnSafe
5705 STAGE RD. MEMPHIS, TN 38134 (901)372-7962
FIGURE 2
FACILITY
SKETCH
CARRIER CORP., COLLIERVILLE, TN.
DATE: 9/8/89
DWG NAME: CARR3

The State of Tennessee, Department of Health and Environment (TDHE) issued a Site Inspection Report (SIR) on the Carrier property in Collierville on 15 September 1986. The report identified three (3) potential sources of trichloroethylene (TCE) on the property.

The report further stated that one or more of the sources may be the cause of trace concentrations of TCE found in the City of Collierville Well field #2 wells, which are located within 2000 feet of the plant building. Table 1 shows results of samples collected from the municipal wells since August, 1986. Samples from the well field were generally collected on a bimonthly basis through December, 1988; at which time the frequency of sample collection was revised to monthly. Maximum contaminant levels (MCLs) promulgated under the Safe Drinking Water Act for 1,1,1-Trichloroethylene (TCE) is 0.005 mg/l.

The three potential sources identified are: a 1979 trichloroethylene spill, a closed, unlined clarifier sludge impoundment, and a trichloroethylene leak discovered in 1985. The facility and location of identified sources are shown in Figure 2.

The known circumstances of these sources are presented as follows:

TABLE 1
ANALYTICAL RESULTS SUMMARY FOR TRICHLOROETHYLENE IN WELLFIELD #2
RESULTS ARE REPORTED IN μg/L

Sampling Date	East Well	West Well	AA BC	AA AC	QA/QC QUALIFIER
08/27/86	2.0	4.0	---	---	
09/09/86	1.8	<1.0	---	<1.0	
02/24/87	3.3	3.4	0.87	0.68	
04/09/87	3.6	3.5	0.53	0.56	
06/18/87	2.3	2.0	---	0.37	
07/02/87	4.5	3.7	1.1	---	B,R
07/16/87	3.6	4.1	1.4	---	B
07/30/87	3.1	3.9	0.92	---	
08/20/87	4.4	8.1	2.0	---	R
09/04/87	2.1	3.3	0.72	---	
09/17/87	1.7	4.0	0.73	---	
10/01/87	2.2	4.5	0.87	---	
10/15/87	1.8	2.6	<0.20	---	
10/29/87	1.6	3.0	0.35	---	
11/12/87	3.0	0.85	0.51	---	
12/03/87	2.0	5.0	0.85	---	
12/17/87	2.0	5.5	0.63	---	B,R
01/04/88	2.9	7.2	1.6	---	B
01/21/88	2.5	6.7	1.3	---	B
02/04/88	12.0	3.4	2.35	---	B
02/18/88	5.2	10.2	1.75	---	C
03/08/88	3.5	8.3	2.1	---	R,C
03/08/88	2.1	8.5	1.1	---	Recra Env.
03/08/88	5.05	4.48	0.99	---	ETC-Memphis
03/23/88	4.2	9.5	2.0	---	C
03/23/88	1.7	7.7	0.77	---	Recra Env.
03/23/88	2.64	8.25	1.65	---	ETC-Memphis
04/28/88	3.0	9.0	2.0	---	
05/17/88	4.0	10.0	3.0	---	
05/31/88	4.0	9.1	2.35	---	
06/13/88	4.4	9.1	2.7	---	
06/27/88	6.0	11.0	4.0	---	

TABLE 1, continued
ANALYTICAL RESULTS SUMMARY FOR TRICHLOROETHYLENE IN WELLFIELD #2 RESULTS ARE REPORTED IN μg/L

Sampling Date	East Well	West Well	AA BC	AA AC	QA/QC QUALIFIER
07/19/88	6.0	9.0	3.5	3.0	
08/17/88	7.5	6.9	2.05	1.8	
09/23/88	8.6	8.5	2.4	4.1	
10/07/88	11.0	13.0	4.0	3.4	
11/03/88	10.0	11.0	3.45	---	
11/17/88	19.0	13.0	6.4	---	R
12/02/88	15.0	15.0	4.3	---	
03/08/89	5.2	9.2	1.9	---	
04/10/89	6.5	4.7	0.86	1.1	
05/15/89	11.0	7.1	1.85	1.6	
06/12/89	17.0	9.0	2.45	2.4	
07/12/89	15.0	9.8	2.4	1.5	
08/10/89	25.0	14.0	3.15	3.1	R,C
09/12/89	16.0	14.0	3.6	2.5	R

Notes:
(1) ---- indicates that no samples were collected.
(2) AAAC indicates after aeration after chlorination in the treatment plant;
(3) Duplicate analyses are averaged for reporting purposes unless the Relative Percent Difference exceeds 25%. In that event, an 'R' QA/QC qualifier is used and the higher value is reported.
(4) QA/QC Data Qualifier Remarks:
B: A 'B' qualifier is used if trichloroethylene is reported in the field blank for this sampling event.
R: An 'R' qualifier is used if the relative percent differences (RPD) of duplicates for this sampling event exceed 25%.
C: A 'C' indicates that the reported value is a corrected value based on subsequent QA/QC review of data.
Lab: Unless otherwise indicated all analyses were performed by CompuChem Laboratories.

1979 Trichloroethylene Spill

On June 20 and 21, 1979, the Carrier plant experienced a sudden spill of trichloroethylene from a heated degreasing unit located on the south side of the plant. The spill reportedly occurred as a result of the failure of a filter cover on the unit. At the time of the spill it was estimated that several thousand gallons of trichloroethylene were lost. The solvent collected on the south parking lot. Residual material was washed off the parking lot by the municipal Fire Department in a generally eastern and southern direction. The asphalt parking lot was reportedly softened by the absorption of the solvent; and was therefore removed for off Site disposal.

A subsequent 1981 investigation of the spill involving test borings and soil analyses was negative for TCE. The investigation involved sample borings to a depth of thirty (30) feet.

Clarifier Sludge Impoundment

On or about 1972, Carrier installed an impoundment for sludge from a wastewater clarifier on the northwest corner of the property. Data from the state's Site Investigation Report indicates that the impoundment was approximately 50' by 48' and contained approximately one foot of sludge at the time it was removed in 1980. The impoundment was used for the storage of clarifier pit sludge which was essentially an alkaline zinc phosphate washer sludge according to plant personnel.

The location of the impoundment has been determined by aerial photography. An undated topographic map and an aerial photograph of the area appear to show an outfall ditch in the southwest corner of the impoundment. The ditch appears to terminate in a topographic depression near the impoundment. The topography of the impoundment area was changed when the impoundment and a layer of subsoil beneath it were removed in 1980.

1985 Trichloroethylene Spill

On January 23, 1985 Carrier experienced a second spill of trichloroethylene as a result of a sudden rupture of an underground pipe from an above ground storage tank holding trichloroethylene. It was estimated at the time of the spill that approximately 500 gallons of TCE were spilled; and approximately the same amount was recovered. In addition, substantial amounts of soil contaminated by trichloroethylene were removed from the area of the leak and disposed of off-Site in a plan approved by the Tennessee Department of Health and Environment (TDHE) in June of 1985. This work was performed by Roy F. Weston, Inc. and the final progress report is included as Appendix A of this Sampling Plan.

1.3 Prior Investigations

Investigations performed from 1981 through 1989 at the Collierville Site have resulted in the installation of approximately 55 shallow soil borings and 18 monitoring wells. To assess characteristics of the Memphis Sand aquifer, an aquifer pump test was completed in May 1988. The scope and results of these investigations are summarized as follows:

Investigation of the 1979 Spill (1981)

Six borings, to a depth of 30 feet around the known area of the spill were sampled and found to be free of TCE at a detection level of 10 parts per billion (ppb).

1985 Spill Response and Investigation

Significant TCE soil contamination was found on excavation of the storage tank, associated piping and up to 15 feet of surrounding soil. Five monitoring wells were installed on the property for purposes of assessing ground water impact (See Appendix A, Weston Report). Table 2 shows groundwater monitoring results from the five Weston wells prior to the state investigation.

TDHE Site Inspection/Investigation (1986)

As mentioned above, the State conducted an investigation of the Site in 1986 to assess impacts of previous spills. Findings include detection of TCE in water from the municipal water

TABLE 2

GROUNDWATER MONITORING ANALYTICAL RESULTS
CARRIER SITE INVESTIGATION (9/86 thru 9/87)
(Values Shown are sum of trichloroethylene
and dichloroethylene in ug/l)

DATE	WELL #1	WELL #10	WELL #12	WELL #13	WELL #14	WELL #1B
09/15/86	260	2.4	<1.0	105*	<1.0	-----
10/20/86	53	1.0	<1.0	120*	<1.0	-----
10/28/86	64	2.8	<1.0	100*	<1.0	-----
11/03/86	210	<1.0	<1.0	110*	<1.0	-----
11/12/86	65	<1.0	<1.0	100*	<1.0	-----
11/20/86	38	<1.0	<1.0	110*	<1.0	-----
12/04/86	46	<1.0	<1.0	97*	<1.0	-----
12/11/86[1]	110*	-----	-----	92	-----	-----
12/17/86	115*	-----	-----	110	-----	-----
12/23/86[2]	73/140*	-----	-----	120	-----	-----
12/30/86	82*	-----	-----	77	-----	-----
01/07/87	105*	-----	-----	98	-----	-----
01/22/87	81/130*	-----	-----	110	-----	-----
01/29/87	120*	-----	-----	120	-----	-----
02/12/87	110*	-----	-----	120	-----	-----
02/18/87	125*	-----	-----	130	-----	-----
02/26/87	110/130*	-----	-----	130	-----	-----
03/05/87	110/130*	-----	-----	140	-----	-----
03/12/87	155*	-----	-----	160	-----	-----
03/20/87	125*	-----	-----	140	-----	-----
03/25/87	190*	<1.0	<1.0	230	<1.0	-----
04/03/87	170/140*	-----	-----	160	-----	-----
04/09/87	130	-----	-----	160*	-----	-----
04/16/87	140	-----	-----	160*	-----	-----
04/23/87	180	-----	-----	190*	-----	-----
04/30/87	180	-----	-----	195*	-----	-----
05/06/87	150	-----	-----	145*	-----	-----
05/14/87	130	-----	-----	140*	-----	-----
05/21/87	220/190*	-----	-----	210	-----	-----
05/28/87	260/200*	-----	-----	190	-----	-----
06/04/87	130*	-----	-----	140	-----	-----
06/11/87	-----	-----	-----	150	-----	-----
06/18/87	220*	-----	-----	210	-----	-----
06/25/87	140/160*	-----	-----	140	-----	-----
07/02/87	200*	-----	-----	180	-----	-----
07/09/87	191*	-----	-----	160	-----	-----
07/16/87	222/273*	-----	-----	59	-----	-----

TABLE 2
GROUNDWATER MONITORING ANALYTICAL RESULTS
CARRIER SITE INVESTIGATION (9/86 thru 9/87)
(Values Shown are sum of trichloroethylene
and dichloroethylene in ug/l)
(Continued)

DATE	WELL #1	WELL #10	WELL #12	WELL #13	WELL #14	WELL #1B
07/23/87	235*	<1.0	<1.0	180	<1.0	-----
08/20/87	195*	<1.0	<1.0	160	<1.0	235
08/27/87	241*	-----	-----	-----	-----	413
09/03/87	212*	-----	-----	-----	-----	404
09/17/87	203	-----	-----	-----	-----	304/341*
09/28/87	165*	-----	-----	-----	-----	300

* Indicates that the sample was collected in duplicate. If the results are within 10% of each other, the average of the two results is reported, but if the results are greater than 10% difference then both results are reported.

[1] Dedicated well pump installed on Monitoring Well #1

[2] Dedicated well pump installed on Monitoring Wells #13, #10, and #14.

supply of the City of Collierville, at Well Field #2. Although TCE was detected, at no time, has the contamination level exceeded EPA maximum concentration limits (MCLs) for TCE in the drinking water. TDHE also detected TCE contaminated soil samples. As a result, Carrier in conjunction with TDHE Division of Superfund agreed to implement a Site Investigation, a plan for which was reviewed and approved by TDHE.

As dictated in the TDHE Site Investigation Plan, a study was undertaken to assess spill impact on soils and ground water by this and other potential releases. As a result 13 additional monitoring wells were installed, and 35 soil borings performed. Well construction and boring logs installed at the Collierville Site are included as Appendix B.

Well monitoring began in September of 1986 by EnSafe personnel. A list of the monitoring results is included as Table 3.

As part of the investigation, an aquifer pump test was performed utilizing the City of Collierville well field (Section 3.2). Analysis of test data indicates that between 1300-27,000 gallons of water per day per acre may leak through the confining layer (aquitard) into the Memphis Sands aquifer.

Impoundment Site

Sampling has been conducted at the former clarifier sludge impoundment Site, to establish presence or absence of sludge or

TABLE 3

GROUNDWATER MONITORING ANALYTICAL RESULTS

CARRIER SITE INVESTIGATION

(10/87 THRU 12/88)

(Values shown are sum of total chlorinated hydrocarbons in ug/l)

WELL #	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	DEC
FLD BLK	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1	215	341	306	224	440	304	303	348	786	470	282	151	90	386
1 (dup)	246	292	225	358	330	324	184	245	442	360	357	228	94	396
1A	(1)	(1)	29	(1)	17	34	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1B	330	648	522	834	867	384	552	467	827	440	560	101	171	490
3	5202	5700	5200	3100	8300	3600	9400	10500	10100	8200	7600	8061	8100	1790
4	48	17	159	223	15	12	50	42	13	82	215	160	134	176
5	6960	8225	10916	8913	10100	9420	4411	10700	4793	10550	13700	8400	10100	5500
6	<1.0	(2)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	---	---	---	1*	<1.0	<1.0
9	(1)	(1)	(1)	(1)	(1)	20	(1)	(1)	(1)	(1)	30	(1)	(1)	(1)
10	<1.0	---	---	---	---	---	<1.0	---	---	---	---	---	---	<1.0
11	(1)	(1)	(1)	(1)	23	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(2)
12	<1.0	---	---	---	---	---	<1.0	---	---	---	---	---	---	(2)
13	100	200	190	210	190	120	140	160	187	140	120	100	100	130
14	<1.0	---	---	---	---	---	<1.0	---	---	---	---	---	---	<1.0
15	---	---	38000	150180	120180	59300	1080	(1)	(1)	(1)	55065	20170	120000	5937
16	---	---	---	---	---	---	---	---	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
19	---	---	37000	19000	17300	3030	19660	15500	18000	17700	14800	11800	22000	4800
21	---	---	36000	20000	16000	384	6400	4940	7480	7700	10660	7100	9950	2400
23	---	---	72	44	32	46	37	57	42	79	61	16	53	38

NOTES:

--- Well not installed or not sampled. Sampling of wells with history of no contamination was discontinued to a semi-annual sampling event.

(1) Insufficient water for sampling.

(2) No sample taken. Access to well blocked.

* Well 6 was apparently damaged from construction equipment prior to the September sampling event.

contaminated soil, and where present, the vertical and horizontal extent and level of contamination.

To assess contamination extent and develop a treatability study scope, a soil-gas survey was conducted by EnSafe personnel in the area of the former impoundment in November of 1988. A sample grid was developed in the area suspected of high contamination and based on soil boring data. The grid was designed to optimize identification of the area impacted by the impoundment. At each grid point a fifteen foot boring was augured. The annulus of the borehole was covered with clear plastic and allowed to sit for a minimum of 24 hours. In order to characterize the former surface impoundment, each borehole was monitored for any vapors that accumulated in the elapsed time using a portable ionization detector (PID).

Treatability Study

An in-situ groundwater recovery and soil-gas venting study has been initiated on the Site at the old lagoon area. This study will be incorporated into the Remedial Investigation Draft and Final Reports. The study, initiated by Carrier Corporation in conjunction with the TDHE, includes a series of groundwater recovery wells screened at the top of the Jackson Clay and connected to a conventional air stripping tower system. Also included are a series of shallow casings screened at depths just below the old lagoon and designed for in-situ soil gas venting.

A full description of the system will also be included in the first RI/FS deliverable, the Historical Data Validation Study.

Additional treatability studies may be considered for the 1979 spill source area depending on initial RI data.

2.0 SAMPLING OBJECTIVES

This plan proposes to obtain and analyze additional samples to meet the following objectives:

(1) Confirm and Validate Previous Work

Verify the Site Constiutents of Concern at each of the three potential source sites, and establish a Confirmed Site Contaminants list for use in subsequent sample analyses and site decontamination procedures; and

Validate an analytical method developed to detect TCE at low levels, with rapid turnaround, in Site samples for soil in the field. These methods will be for screening only.

All sample validation will follow those guidelines set forth in the Collierville Work Plan. The three possible data classes are:

- Unusable data: Data that may not be used for any purpose;
- Class A data: Data that meets only the Class A screening criteria (contained in the QAPP) but not the Level B criteria. This class of data may be used for qualitative purposes only, e.g., to help develop or refine study plans, evaluate different sampling or analytical techniques, or identify gaps in the data base. For this investigation, data will be labeled Class A as long as all documentation identified by the QAPP have been properly prepared and are available.

- **Class B data**: Data that meets both the Class A and Class B screening criteria. In addition to qualitative uses, the data submitted also may be used for quantitative purposes such as evaluating conditions such as risks or potential remedial solutions. For this investigation, data will be classified Class B if all analytical and field QC samples (rinsates, blanks, and spikes) are within acceptable control limits, and all indications of sample representativeness are positive.

(2) Collect Additional Data

In order to determine the areal extent, if any, of contamination from trichloroethylene releases and the corresponding relationship to the saturated zones additional data, to fill data gaps from the previous investigation, will need to be gathered. This information will be used to address the following:

- Assess whether significant releases of hazardous substances in surface water run off to Nonconnah Creek have occurred and subsequent boilogical affects upon the benthic zone.

- Characterize soils and local hydrogeology to determine mobility, contaminant migration, and impacts of released substances, if any.

- Identify and assess extent and feasibility of alternatives for remediation. Specifically, continue to assess the treatability of soil by vacuuming (soil venting) and ground water by shallow well recovery and air stripping at the impoundment Site; and as feasible at the 1979 spill Site.

Analytical Procedures

Three types of analytical procedures will be employed in the investigation.

1) Rapid turn-around Gas Chromatograph (GC) analyses for TCE in soil borings will be performed to provide quantitative data for TCE in subsoils. The method employs a codistillation process which yields very low method detection limits (Appendix B).

2) Head space analysis (of the soil samples) utilizing a PID, will be for qualitative data and used for screening purposes. The photoionization detector will be calibrated in the field at the beginning and end of each day. The unit will be calibrated with an appropriate span gas per manufacturer guidelines.

3) Selected initial soil samples will be analyzed for the full Contract Laboratory Program (CLP) Target Compound List and Target Analyte List (TCL/TAL) constituents, with subsequent analyses limited constituents which are detected at statistically significant levels (Confirmed Site Contaminants, Table 4). A list of TCL/TAL parameters and method detection limits is found in Appendix C.

Samples collected during this investigation which do not meet quality control criteria will be rejected and replacement samples will be collected as stated in the Work Plan.

2.1 Summary of the Field Investigation - Phase I

To obtain the data necessary to perform the data validation, an initial Phase I Field Data Collection Task will be performed.

1) Four borings will be drilled on the Site. One boring will be placed in each of the three (3) identified source areas. The fourth boring will be placed in a area assumed to be free of Site contaminants and therefore representative of background concentrations on the Site. Split spoon samples will be taken at approximately 8 foot intervals. Each boring will be terminated upon encountering the Jackson Clay stratum (yielding an average of 6 samples per boring).

2) These 24 soil samples will be split and analyzed in two different ways. One split of each sample will analyzed using full CLP protocol for the Target Compound and Analyte Lists. The remaining split will be analyzed using the TCE field screening method developed during the preliminary investigation. A comparison of the results of this split will be used to perform the data validation study described above.

3) All on Site monitoring wells capable of producing sufficient sample for analysis will be sampled during the Phase 1 work elements. This will produce 13 groundwater samples from the Site. These samples will be split for analysis. One split will be analyzed using CLP methods for the full Target Compound and Analyte Lists while the other split will be analyzed by EPA Method 624 which has typically been used on the Site in the prior investigations. A comparison of the results of this split will be used to perform the data validation study described above.

4) The Site topographic map will also be updated during the Phase 1 field activity. This map will be updated in conjunction with field surveys of the boring locations.

A report summarizing the results of the Phase I Field Activities and a review of historical data will be prepared for the Carrier Corporation and EPA review prior to the start of additional sampling activities. This historical data will then be used as classified to supplement data to be obtained in the RI/FS. In addition, Confirmed Site Contaminants will be identified in Phase I and used to select subsequent analytical protocols and decontamination methods in Phase II of the RI/FS.

2.2 Summary of Field Investigation - Phase II Field Activities

After completion of Phase I and review of the Phase I report, Phase II field activities will be initiated. Phase II will consist of the work elements described below. In addition, Phase II will include replication of any data points deemed unusable in the Historical Data Review.

To further assess the potential impact on Nonconnah Creek of the TCE releases that have occurred on the Site, a biological population study will be included in the investigation. This study will consist of a population size and species diversity study comparing benthic flora and fauna upstream of the Site with benthic flora and fauna downstream of the Site. Benthic organisms have been chosen because of their inability to migrate away from a contaminant source and the high specific gravity of TCE which is believed to result in greater stress on benthic organisms. Species diversity and population sizes will be used to assess relative impacts by the Site on the stream. In addition, a sediment sample will be collected at each location of a biological study. This sediment sample will be analyzed for the full CLP Target Compound and Analyte List constituents.

Geophysical Surveying

All proposed well borings on the Collierville Site will be surveyed, using a natural gamma ray logging instrument. This will be performed using a Mount Sopris Instrument Company, Model 1000-C portable borehole logger (or similar instrument) with a gamma detection probe. The Mount Sopris unit has a continuous chart-type recorder. The gamma logging of the deep borings should aid the geologic correlation and thickness determinations of the sandy aquifer and clay aquitard units present at the Site. It will also be used to verify the geologic descriptions on file for the existing wells. Because this investigation deals with an area of unconsolidated sediments, only gamma ray logging will be performed since it can be conducted through cased wells.

Soil Borings/Monitoring Wells

Phase II of the RI/FS will also consist of an additional sixteen shallow borings completed to the top of the Jackson Clay. Nine of the borings installed in the RI/FS will be completed as shallow monitoring wells and are further described in Section 4.

3.0 SCOPE AND DESIGN OF SAMPLING APPROACH

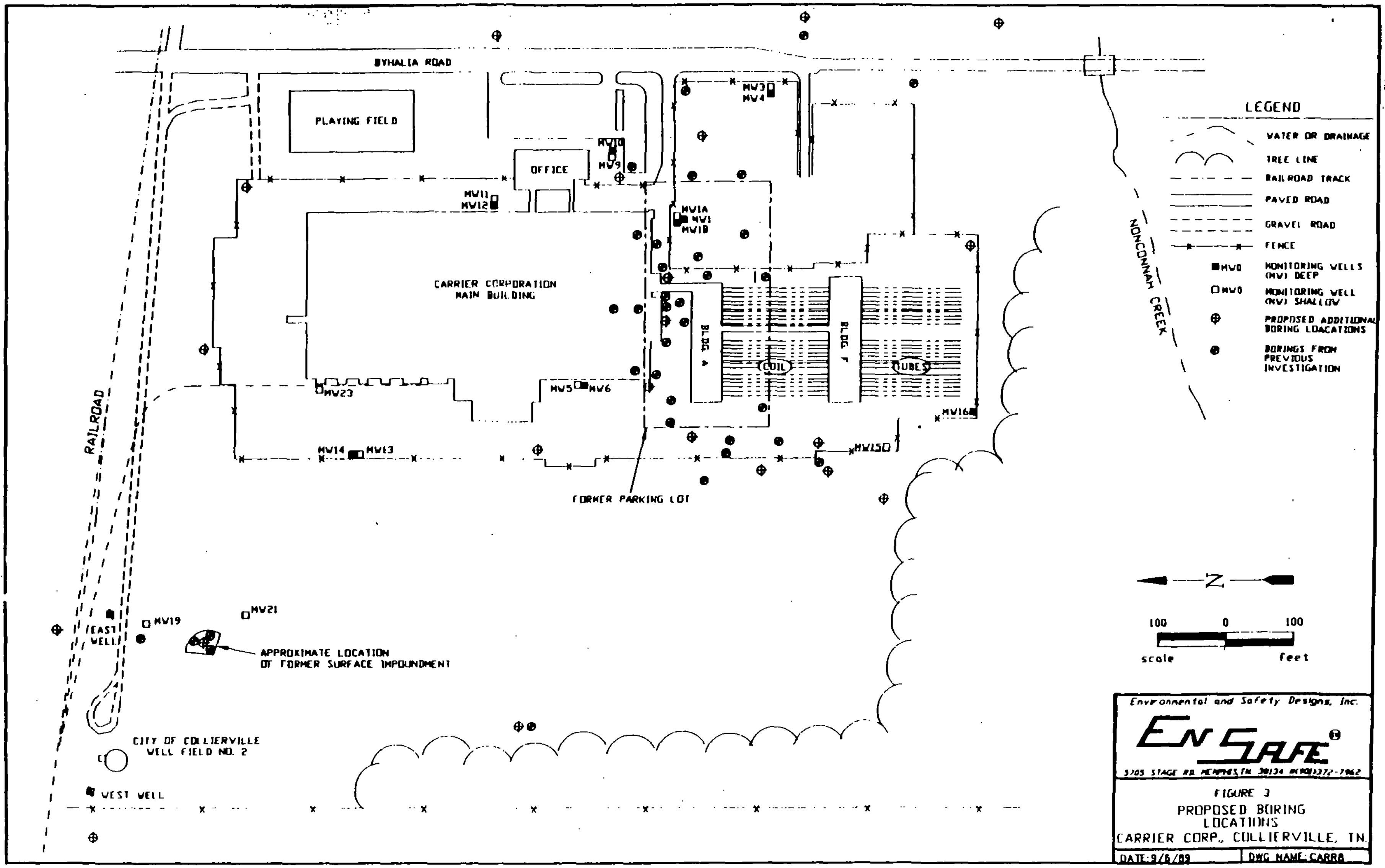
On the basis of early work, it was determined that the primary pathway of contamination from TCE source sites is via groundwater, specifically shallow ground water, apparently above a confining clay layer. Below this clay layer is a second aquifer, the Memphis Sand. This aquifer serves as the water source for the City of Collierville and has been sampled and determined to contain amounts of TCE. Figure 2 depicts the location of the Collierville City wells, and those monitoring wells installed by Carrier to gage impacts of releases.

Approximately fifty five (55) soil boring locations have been sampled in previous investigations, resulting in a substantial characterization of the impact of known TCE release sources and surrounding areas.

To supplement this work (specifically to complete the determination of areal and vertical extent of contamination), a series of twenty (20) additional shallow borings will be augured, nine (9) of which will be completed as monitoring wells during the RI/FS (Figure 3).

3.1 Rationale

The location and analytical protocol for samples collected from


BYHALIA ROAD
PLAYING FIELD
OFFICE
MW10
MW9
MW11
MW12
MW3
MW4
MW1A
MW1
MW1B
CARRIER CORPORATION
MAIN BUILDING
BLDG. A
BLDG. F
COIL
TUBES
MW23
MW5
MW6
MW14
MW13
MW15D
MW16
FORMER PARKING LOT
RAILROAD
NONCONNAH CREEK
EAST WELL
MW19
MW21
APPROXIMATE LOCATION
OF FORMER SURFACE IMPOUNDMENT
CITY OF COLLIERVILLE
WELL FIELD NO. 2
WEST WELL
LEGEND
WATER OR DRAINAGE
TREE LINE
RAILROAD TRACK
PAVED ROAD
GRAVEL ROAD
FENCE
MWO MONITORING WELLS (MW) DEEP
MWO MONITORING WELL (MW) SHALLOW
PROPOSED ADDITIONAL BORING LOCATIONS
BORINGS FROM PREVIOUS INVESTIGATION
N
100 0 100
scale feet
Environmental and Safety Designs, Inc.
EnSafe
5705 STAGE RD. MEMPHIS, TN 38134 (901)372-7962
FIGURE 3
PROPOSED BORING
LOCATIONS
CARRIER CORP., COLLIERVILLE, TN.
DATE: 9/6/89
DWG NAME: CARR8

these new borings are chosen considering the following corollary goals:

- o Verify past sampling and analyses.
- o Obtain additional geological data pertaining to the Site.

The location of all borings is not final. The approach to placement will be phased and dependent on the following:

- o an audit of the quality of data stemming from previous investigations and a reassessment of data gathering needs, and
- o results of Phase I sampling events planned herein (the contamination levels in any location will improve insight into optimal location for placement of additional borings).

The Phase I investigation of the RI/FS will incorporate one soil boring advanced to the saturated zone above the Jackson Clay in each of the following study areas:

1) the 1979 spill site,
2) the 1985 spill site,
3) the former surface impoundment, and
4) a background sample from an area presumed to be free of contaminants.

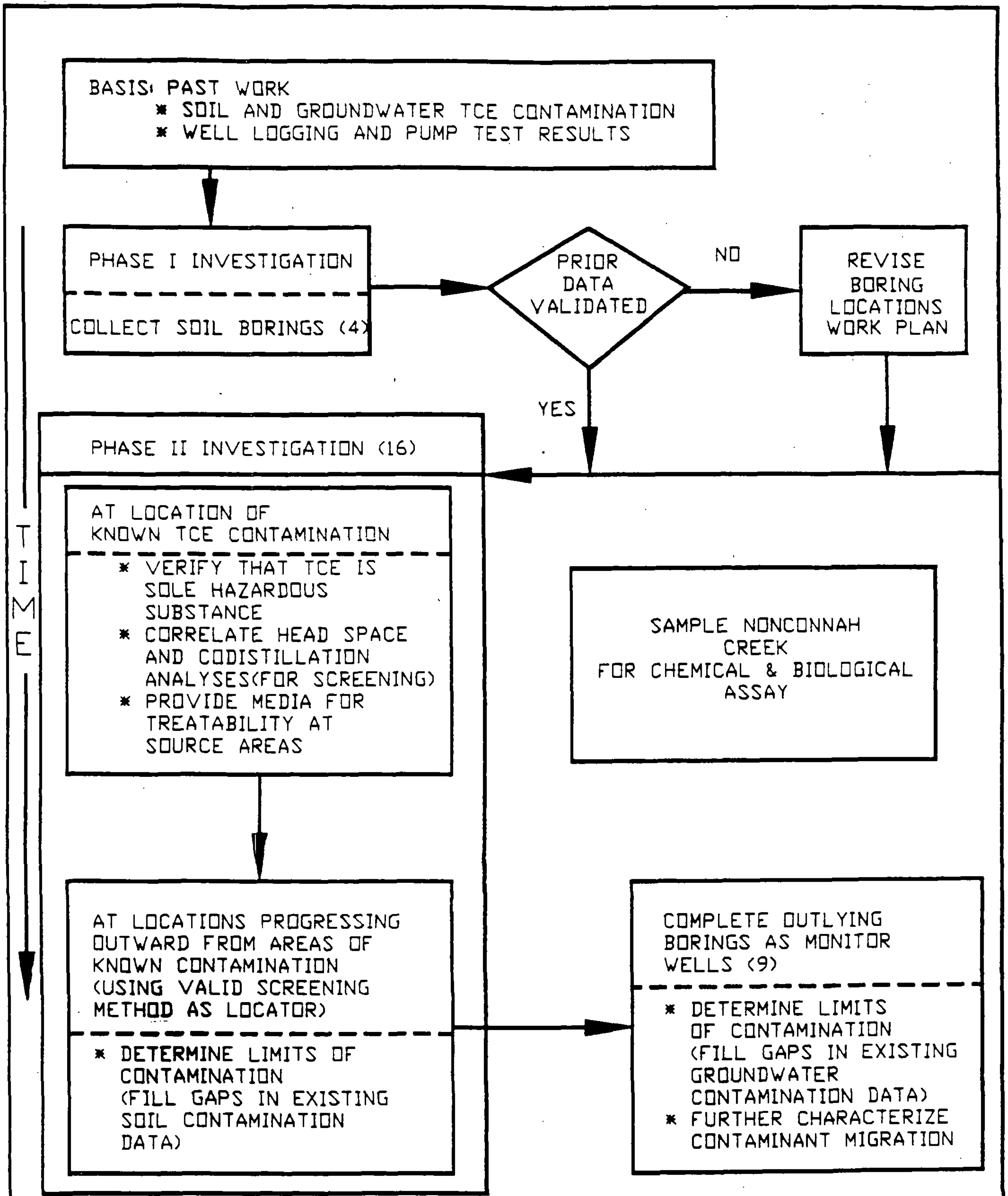


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FIGURE 4
FLOW DIAGRAM
SAMPLING APPROACH

DATE: 9/6/89 | DWG NAM

Subsequent borings and well installations will occur as Phase II of the Site investigation. Figure 4 presents a schematic of the general approach to sampling the Collierville Site. The following discussion details rationale for sampling at areas within the Site.

3.2 Aquifer Investigation

To determine the areal extent of groundwater contamination within the shallow aquifer, an additional nine (9) shallow wells will be installed during Phase II of the investigation. The proposed locations of these wells are; north of the main building, west of the municipal well field, and south-southwest of the former impoundment. Three (3) wells will be installed east of Byhalia Road to monitor groundwater conditions east of the Site. No wells are planned for the confined aquifer on the Carrier property. The previous investigations have indicated elevated levels of TCE in the shallow aquifer; therefore, to avoid risk of providing a conduit for cross contamination no deep wells are being proposed.

In May of 1988, EnSafe, in association with Dames and Moore, completed an aquifer pump test at the Collierville Site. The test was performed on the lower aquifer (Memphis Sand) using the west well of the Collierville municipal well field just west of the plant. The test was conducted to compute aquifer characteristics and to estimate the effectiveness of the confining aquitard that separates the shallow aquifer from the Memphis Sand aquifer supplying groundwater to the municipal wells. The eas municipal well and monitoring well MW-14 were used as the primary observation wells. Water levels in all on Site wells were periodically measured during the test.

In preparation for the aquifer tests, the pumps in the municipal wells were shut down on April 11, 1988 so that the water levels could return to natural equilibrium. Pressure transducers connected to data logging units were installed in the two municipal wells and MW-14 on April 14, 1988. Antecedent water level measurements were recorded hourly from the afternoon of April 11, 1988 through the afternoon of April 18, 1988. The aquifer pumping test was then initiated the evening of April 18, 1988 and continued until the morning of April 21, 1988.

Static water level measurements from each of the monitoring wells in the lower aquifer taken on April 18, 1988 before pumping began were used to construct a potentiometric contour map for the lower aquifer. The map indicates that groundwater movement in the Memphis Sand at the Site is toward the northwest. Therefore, the municipal well field is directly downgradient of the Carrier plant. Water level measurements collected from the same wells during the aquifer test while a pumping stress was placed on the aquifer system shows the pumping had no obvious effect on groundwater flow direction or gradients in the plant area. The only noted effect was a nearly uniform decrease in water levels of about 0.5 foot.

Analysis of the aquifer pumping test data indicates that between 1,300 and 27,000 gallons per day per acre could be leaking through the confining aquitard into the lower aquifer.

From the contour map, the hydraulic gradient was measured to be 0.0017 ft/ft. Other aquifer characteristics were derived from the aquifer pumping test:

Transmissivity	**Storage coefficient**	**Vertical permeability**	**Horizontal permeability**
(gpd/ft)	(dimensionless)	(gpd/ft2)	(gpd/ft2)
242,500	0.001-0.0001	0.03-0.62	1,212.5

The effective porosity is estimated to be 25% for the aquifer. The groundwater velocity is calculated to be about eight feet per day during non-pumping conditions. Flow velocities are not expected to differ from this value during pumping of the municipal wells except in the immediate vicinity of the wells. The cone of depression, developed from pumping the aquifer at approximately 470 gallons per minute, was rather broad but not very deep, which is typical of formations with high transmissivity values.

Vertical hydraulic conductivity values have been calculated for the Site from data generated during the aquifer pumping test.

Permeability tests performed on clay samples collected from the Jackson Formation confining strata indicate that the permeability of the clay is in the range of 1 x 10-7 to 1 x 10-8 cm/sec. However, vertical permeability values derived from the Walton Leaky Artesian Aquifer pumping test analysis were calculated to be 2.9 x 10-5 and 1.7 x 10-6 cm/sec for the two observation wells. These values translate to 1,300 to 27,000 gallons per day per acre. The value used for calculating the vertical leakage through the confining aquitard is 1.0 ft/ft.

Using the parameter values for vertical hydraulic conductivity and hydraulic gradient and an estimated value of 10% for the effective porosity of the confining clay, the vertical flow velocity through the confining Jackson Formation is on the order of 0.04 to 0.83 feet per day.

A complete report on the aquifer pump test will be reprinted in the RI Report. A pump test on the upper alluvial aquifer is not considered feasible due to the perched nature of this system.

3.3 Trichloroethylene Spills

Two potential sources of TCE contamination were identified at the Site as mentioned in Section 1.0; the 1979 spill Site southwest of the main plant, and the 1985 spill south of the plant office.

The Phase II investigation of the 1979 spill will continue south to the ditch which traverses the property in the southwest section (Nonconnah Creek). Subsequent samples for the 1985 spill will concentrate south and southwest of the documented spill. Previous investigations (1985 spill) have indicated soil contamination not exceeding 10 ppb.

Shallow soil borings will be made specifically to investigate the nature and distribution of soil contamination in this area. Soil borings will be advanced to the top of the saturated zone. Samples will be collected at five foot intervals using a split-spoon sampling device. Samples will be analyzed both using field and laboratory methods for trichloroethylene and its decomposition products.

3.4 Clarifier Sludge Impoundment

At least one boring will be augured to obtain soil samples for parallel analysis by head space, codistillation and full Target Compound List/Target Analyte List (TCL/TAL). The intent is to assess presence, if any, of hazardous substances other than TCE. This boring will be advanced to the saturated zone with samples collected at eight foot intervals.

Soil samples will be split vertically after being logged by the Site geologist. One sample will be preserved at 4 degrees C for laboratory analysis. The other will be kept on Site at room temperature. A PID instrument will be used to measure the head-space concentrations of organic vapors in each sample jar. The organic vapor analyzer will also be used for monitoring ambient air standards for personnel health and safety.

No bore holes will be backfilled with contaminated soil. Soil borings will be backfilled with a slurry of Type 1 Portland Cement and a pure powdered sodium bentonite. The cuttings obtained from drilling will be placed in 55 gallon drums and held in a hazardous waste storage facility on the Carrier Site. Pending results of the laboratory analyses, contained cuttings will be handled either as hazardous waste (for off-Site disposal) or as uncontaminated fill.

Summary

One sample from each boring is proposed for CLP TCL/TAL analysis in Phase II of the RI/FS. The sample selected for complete CLP analsis will be based upon the highest recorded PID reading from headspace analysis. All remaining samples will be submitted for Level A type screening utilizing the aforementioned procedures (Section 2.0). Table 4 summarizes the scope of sampling and analysis (both completed and planned) and is summarized as follows:

Phase I Investigation

The Phase I investigation will consist of four (4) borings with an average of six samples per boring. (Figure 5) These twenty

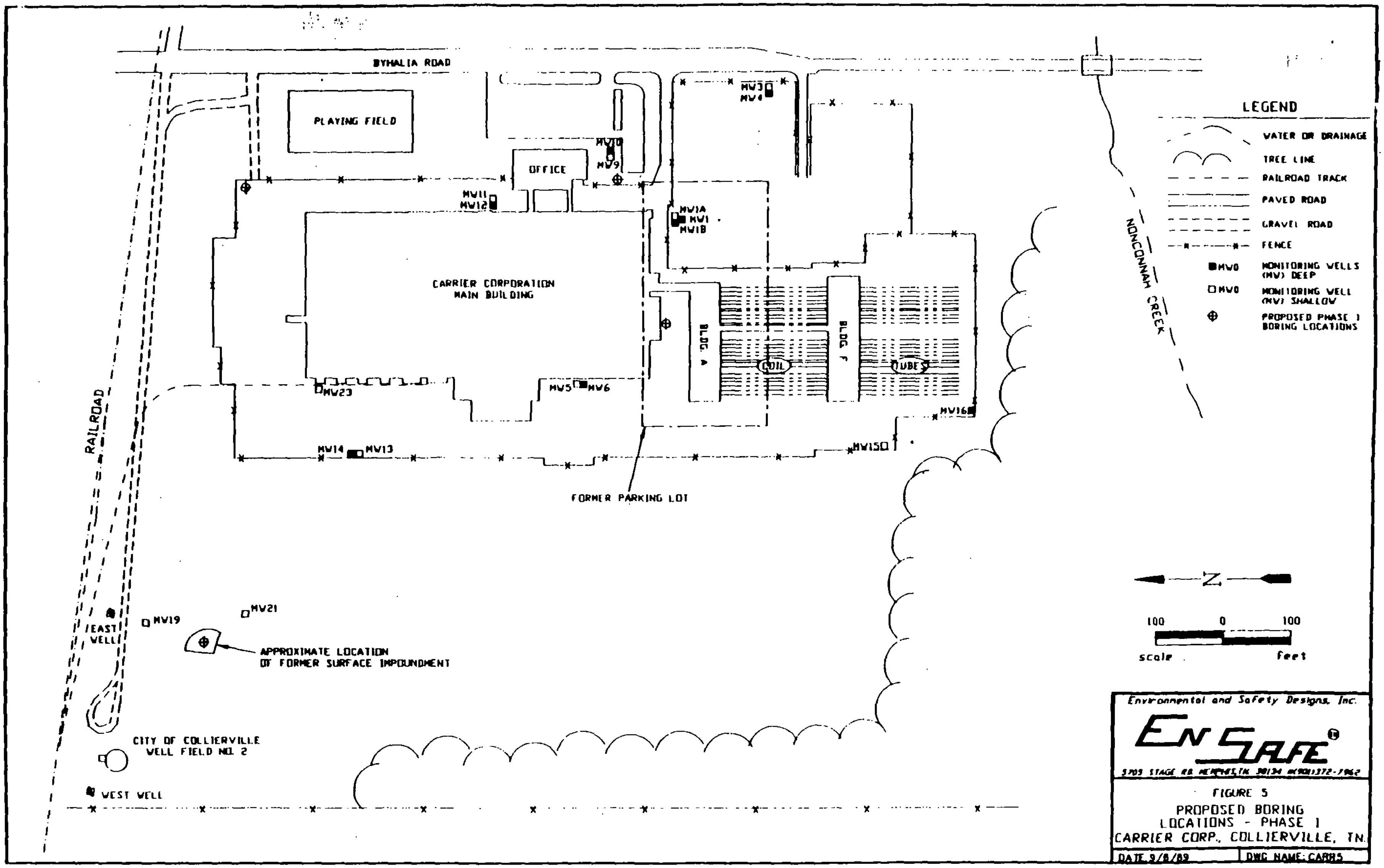

FIGURE 5
PROPOSED BORING
LOCATIONS - PHASE 1
CARRIER CORP., COLLIERVILLE, TN.

TABLE 4
ANALYTICAL MATRIX

MEDIA		ANALYSIS: (CLP) TCL/TAL LEVEL IV	TCE* SCREEN	[1] CONFIRMED SITE CONTAMINANTS LEVEL IV	FIELD AND HEADSPACE SCREENING
SOILS	COMPLETED	0	192	0	192
	PLANNED	24	160	16	160
GROUNDWATER	COMPLETED	0	>300	0	0
	PLANNED	13	0	81	0
SURFACE WATER	COMPLETED	0	3	0	0
	PLANNED	0	0	0	0
SEDIMENT	COMPLETED	0	3	0	3
	PLANNED	2	0	0	2
AIR	COMPLETED	N/A	20	N/A	192
	PLANNED	N/A	N/A	N/A	160
TOTALS		41	>679	97	709

*Contingent upon quality assurance confirmation of method.

[1] Confirmed Site Contaminants will be determined from Phase I sampling. Phase I analytical will include full CLP TCL/TAL.

four (24) soil samples will be split and analyzed in two different ways. One split of each sample will be analyzed using full CLP protocol for the Target Compound and Analyte Lists (24 total samples). The remaining splits will be analyzed using the TCE field screening method developed during the preliminary investigation (24 total samples).

All on Site monitoring wells capable of producing sufficient sample for analysis will be sampled during the Phase I work elements. This will produce thirteen (13) groundwater samples from the Site. These samples will be split for analysis. One split will be analyzed using CLP methods for the full Target Compound and Analyte Lists while the other split will be analyzed by EPA Method 624 which has typically been used on the Site during prior investigations. A comparison of the results of this split will be used to perform the data validation study described in Section 2.0.

Phase II Investigation

After completion of Phase I and review of the Phase I report, the Phase II field activities will be initiated. Phase II will consist of sixteen (16) additional borings (Figure 6). One sample from each boring will be analyzed for those confirmed Site contaminants utilizing CLP procedure (16 total samples). These samples will be chosen based upon the highest headspace reading utilizing a PID. The remaining samples (one per five foot

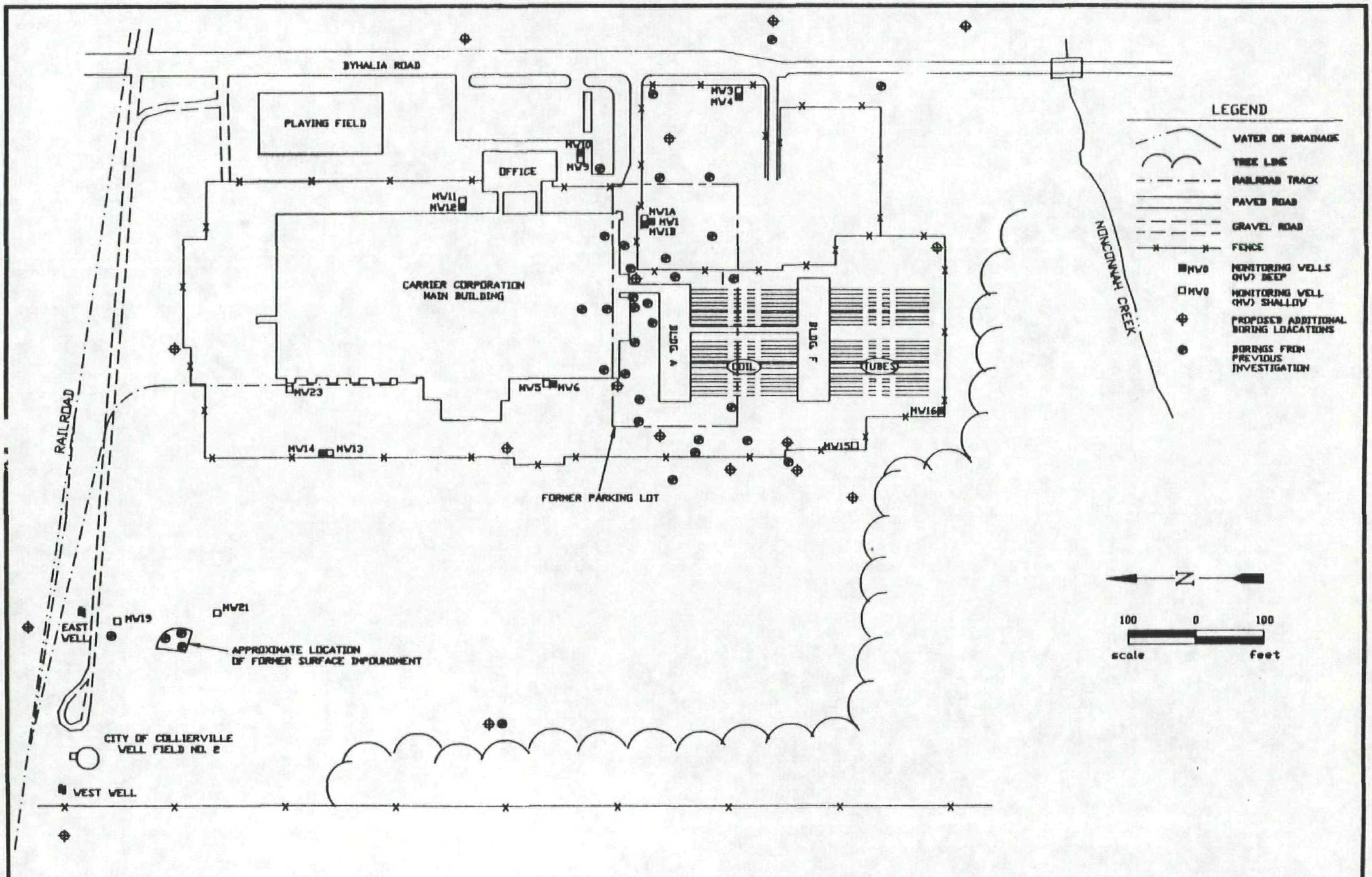

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FIGURE 6
PROPOSED BORING LOCATIONS - PHASE II
CARRIER CORP., COLLIERVILLE, TN.

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interval) will be analyzed using the TCE field screening method developed during the preliminary investigation (132 samples).

Nine (9) of the initial twenty (20) borings in the RI/FS have been proposed to be completed as monitoring wells (Figure 7). All wells will be sampled on the Collierville Site on a quarterly basis for a period of one year upon completion and successful development for confirmed Site contaminants based on the results of the Phase I groundwater sampling (81 total samples).

Sediment samples will be collected at random locations in Nonconnah Creek in conjunction with the proposed biological study (Section 4.5.3). These sediment samples will be analyzed for full CLP Target Compound and Analyte List constituents (2 samples total).

Exact number of analyses for each category will be dependent on the results of a validation of previously obtained data as described in Section 2.0 of this document, successful correlation of the codistillation method for TCE, and results of initial CLP TCL/TAL analyses.

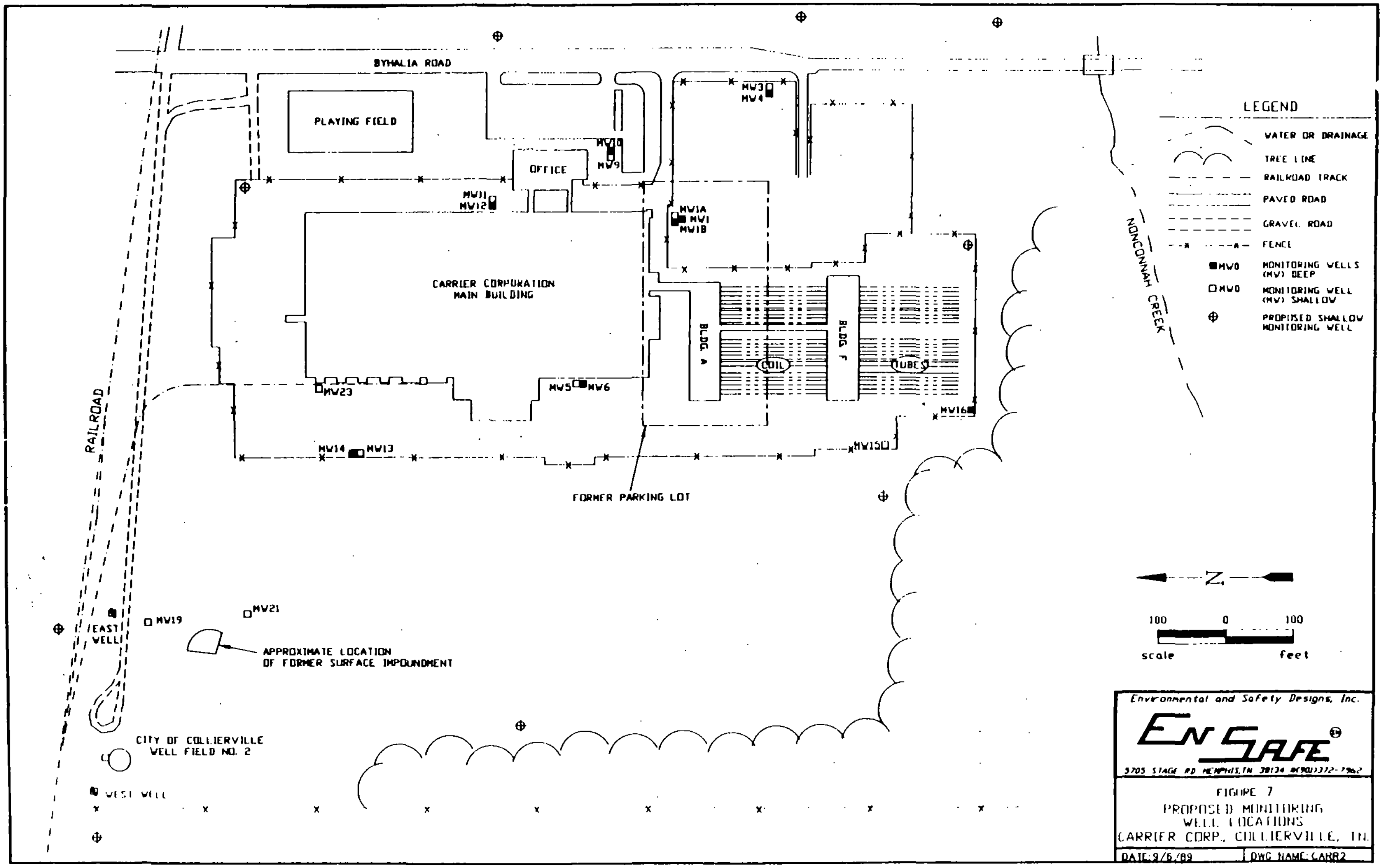

FIGURE 7
PROPOSED MONITORING
WELL LOCATIONS
CARRIER CORP., COLLIERVILLE, TN.

4.0 SAMPLING METHODOLOGIES

Previous sections of the Sampling Plan have indicated that a two phased approach would be incorporated to implement the RI/FS at the Collierville Site. All soil and groundwater samples will follow the guidelines set forth in this Section.

4.1 Soil Samples

Soil samples will be collected from each of the proposed boring and well locations. Shallow soil borings will be used to identify the source area(s) of groundwater contamination. The borings will be drilled in the approximate locations shown on Figure 3. Soil samples from each boring will be collected at specified intervals using a split-spoon sampling device. These samples will be visually classified by an experienced geologist. The samples will then be split into representative samples in accordance with the EPA SOP/QA Manual to minimize the possibility of volitization. Each sample will be placed in a separate moisture-proof glass jar and labeled for identification. One sample jar will be preserved at 4 degrees C in an ice chest to be transported to the analytical laboratory. Sample containers for analytical samples will be either forty (40) ml vials or eight (8) ounce wide mouth jars which will be packed with soil sample to minimize head-space in the jar. The other sample will be kept in a standard sample jar at room temperature. A qualitative head-space analysis will then be performed using a photoionization detector (PID) to measure organic vapor concentrations accumulated in the sample jar.

Soil samples chosen for CLP laboratory procedures will be based on the results of head-space analysis. Specified Phase II samples with the highest PID readings will be sent to the contract laboratory for analysis of confirmed Site constituents. All remaining samples from the borings will be analyzed as described in Section 3.0. This method will enable the source area(s) to be identified based on relative TCE concentrations measured at various locations and depths.

Individual borings and the subsequent samples which do not indicate accumulated organic vapors from headspace will be analyzed for the confirmed site constituents. Three samples will be collected from each boring; the surface, approximate middle, and the bottom.

A total of twenty (20) soil borings will be made at the Site in both phases of the investigation to characterize the potential source area(s) during the RI/FS. Each boring will range to the saturated zone or to the top of the Jackson Clay confining unit, whichever occurs first. Soil samples will be collected at specified intervals from these borings. Nine (9) soil borings will be completed as monitoring wells. These soil samples will be used to characterize the Site geology and potential transport pathways in the subsurface. Soil samples from the proposed monitoring well locations will be collected at five (5.0) foot intervals. It is expected that the depth of the borings will range from 35 feet to 50 feet.

4.1.1 Sampling Procedures

The following precautions will be taken for all samples collected in order to prevent cross contamination:

A clean pair of latex surgical gloves will be worn each time an individual sample is collected.

A field sampling team will consist of at least two people. One person will collect the sample while the other person keeps complete notes on all sampling procedures and day to day activities.

Sample collection activities will proceed progressively from the previously described Phase I and Phase II scenario.

All disposable sampling equipment will be containerized in 55 gallon steel drums and disposed of properly at the end of the investigation. Section 4.1.2 describes this procedure in more detail.

Sample Identification

All samples will be identified and fully documented in the field records, on the chain-of-custody records, and on the sample labels and sample tags. Any samples that are thought to be potentially hazardous (i.e. corrosive, flammable, poison, etc.) will be identified as such in the field records, on the chain-of-custody records, and on the sample tags.

Collection of Auxiliary Data

All auxiliary data relative to a particular sampling location will be collected as close to the sample collection time as possible. Auxiliary data will include field measurements such as pH, conductivity, temperature, etc. when applicable. Photographs of sampling events will be made in order to keep records of all activities. The field records will include all information about weather conditions and other activities that occur during the sampling events. Boring logs will be maintained for all boreholes. Pumping rates and water level measurements will be documented for all events involving sampling of the monitoring wells. Times of all events involved in the investigation will be recorded. In short, all pertinent information will be documented.

Sample Chain-of-Custody

Sample chain-of-custody will be maintained during all field investigations for all samples collected. An example of the chain-of-custody form that will be used during the investigation of the Collierville Site is illustrated in the corresponding QAPP.

4.1.2 Decontamination Procedures

To prevent cross-contamination during the Phase I RI/FS, all equipment (sampling, drilling, mobilization, etc.) that is used during the investigation will be decontaminated in accordance with the EPA Region IV SOP/QA Manual (SOP/QA Manual) dated April 1, 1986, Appendix B. All decontamination procedures will take place in a contained area which will be constructed before the investigation begins. The containment basin will be large enough to decontaminate all vehicles involved with the investigation of the Collierville Site (drill rig, mobilization vehicles, etc.). All waste water collected in the containment basin will be pumped into 55 gallon steel drums and maintained on site for proper disposal with other wastes from the investigation.

All sampling spoils will also be containerized in 55 gallon steel drums and maintained on site for proper disposal. These wastes include auger spoils from drilling, and all disposable sampling equipment, etc. All wastes will be properly disposed of following the investigation in accordance with all applicable federal and state laws.

Sampling equipment such as the split spoon sampler, hollow stem augers, and any other reusable equipment that may be utilized during the sampling events will be decontaminated in a seven step decontamination procedure. The procedure is as follows:

1) Equipment will be washed thoroughly with laboratory detergent (Alquinox™ or Liquinox™) and hot water using a brush to remove any particulate matter or surface film.
2) Equipment will be rinsed thoroughly with hot tap water.
3) Equipment will be rinsed with at least a 10% nitric acid solution.
4) Equipment will be rinsed thoroughly with deionized water.
5) Equipment will be rinsed thoroughly with an isopropanol rinse.
6) Equipment will be rinsed thoroughly with a hot tap water rinse.
7) Equipment will be rinsed thoroughly with deionized water, and allowed to air dry; or rinsed with organic free water

Each rinsing solution will be kept in a plastic bucket designated specifically for that solution. Solutions will be changed between each individual equipment rinse. When each solution is changed, each waste material will be poured into a 55 gallon steel drum marked specifically for that waste. When each drum has been filled, a sample will be collected and sent to CompuChem for analysis to determine if the water is contaminated or not. If the water is contaminated, it will be maintained on site and disposed of properly with the other waste from the investigation. If the water is not contaminated, it will be poured onto the ground at the Site.

Phase II decontamination procedures will be modified to address those confirmed Site contaminants identified during Phase I of the study. In particular, Phase II decontamination steps will focus on removing volatile organic contaminants. The likely Phase II decontamination rinse will consist of a tap water rinse, steam cleaning, isopropanol rinse, air drying, and a final deionized water rinse.

4.2 Groundwater Samples

During the Phase I and Phase II investigations of the RI/FS groundwater samples will be collected from all existing and proposed wells at the completion of installations and development. This will include nineteen (19) shallow and eight (8) deep monitoring wells, each set providing samples from either the shallow or deep aquifer units respectively. These samples will be used to characterize the groundwater quality of each aquifer unit, identify the migration pathways, and delineate the contaminant plume(s).

During each sampling period, a groundwater level will be measured and recorded for each well. These measurements will be converted to elevations relative to a set datum (mean sea level). Prior to collecting groundwater samples, each well will be purged of standing water within the well casing. The equivalent of approximately three casing volumes of standing water will be evacuated or the well will be bailed dry to ensure fresh groundwater recharge for sample collection. Bailing, sampling, and water level measurement equipment will follow those procedures outlined in Appendix A of the EPA SOP/QA manual.

Groundwater samples will be collected from each monitoring well quarterly beginning with the Phase I investigation of the RI/FS. Groundwater samples from the Collierville Site will be collected in pre-cleaned 40 ml septum vials (VOAs) and 1000 ml glass jars (both types of containers are equipped with Teflon™ lined lids) after each well has been developed. The samples will be cooled to 4 degrees C as a preservative in accordance with the requirements of EPA Methods.

Samples will be collected on the new wells by use of the following:

Deep: dedicated well pumps
Stainless Steel Pump with Teflon™ Bladder and Stainless Steel Inlet Screen; utilizing 3/8" Teflon™ coated cable attached to a portable Pneumatic Controller

Shallow: bailers
Teflon™ construction with Molded Caps and Threadless Joints; attached to Teflon™ coated Stainless Steel Wire

At project start, monitoring will be implemented on a quarterly basis for a period of one year. After an initial screening of samples for full TCL/TAL constituents, subsequent analyses will be limited to confirmed Site contaminants.

4.5.3 Nonconnah Creek Sediment Samples

To support the biological study of Nonconnah Creek, two sediment samples will be taken in the Creek. One sediment sample will be taken in the upstream study location and one will be taken at the downstream study location (Figure 8). The Creek sediment samples will be collected with hand trowels or scoops. To avoid localized variations in sediment, three grab samples will be taken within a 10 foot radius area and composited into a single glass container. Each composite sample location point will be staked, photographed, and recorded.

The sediment samples will be analyzed by CLP procedures for the full Target Compound and Analyte List constituents.

4.5.4 Drinking Water Samples

Samples of raw and finished drinking water from the Collierville Wellfield #2 will also be collected and analyzed. Intervals for this testing are still tentative but are expected to be timed to correlate with on-Site monitoring well tests (subject to approval of the well owner). These samples will be analyzed in Phase I by CLP procedures for Target Compound and Analyte List Constituents and by Method 601 to assist in validating historical data.

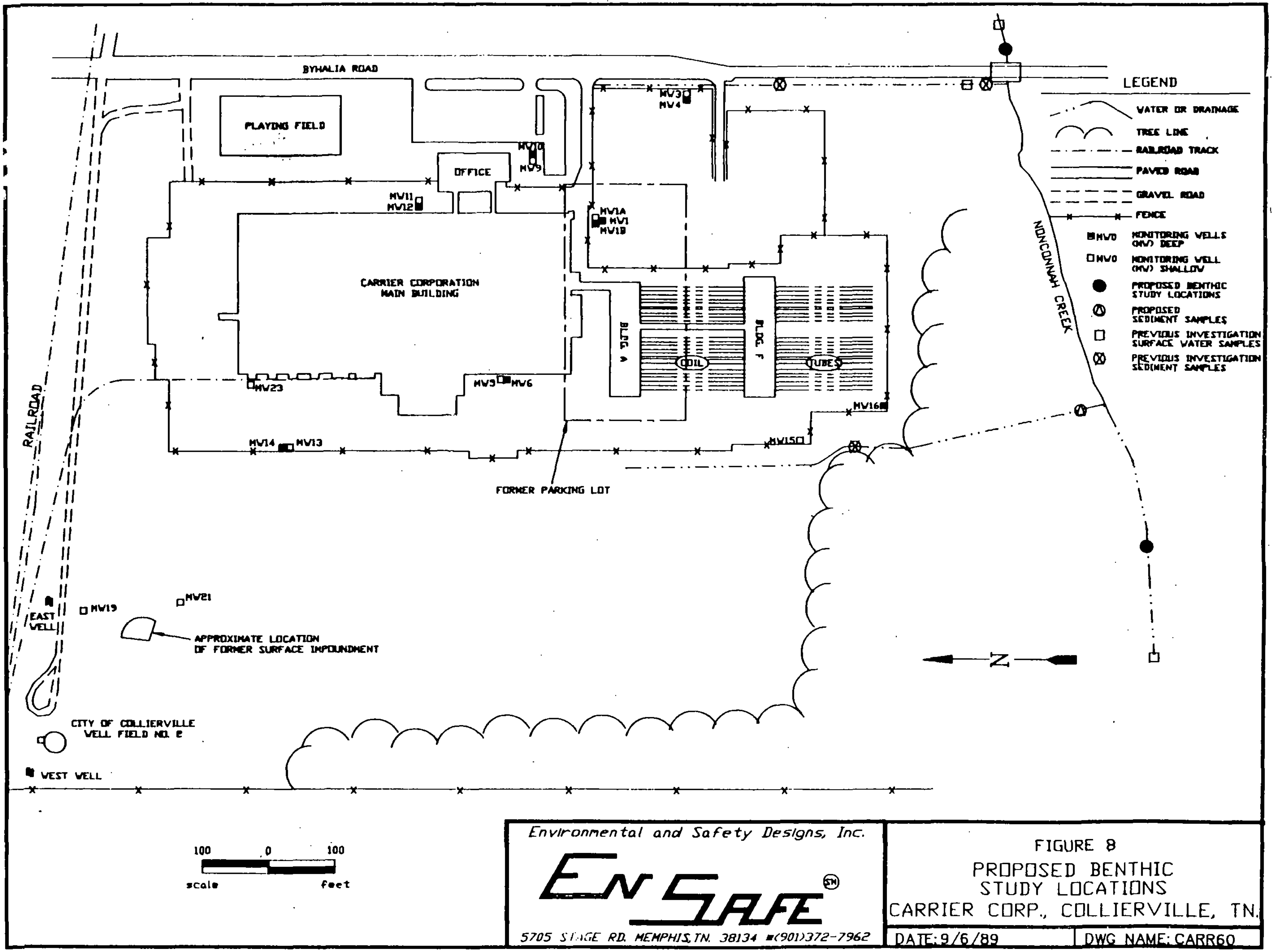

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FIGURE 8
PROPOSED BENTHIC
STUDY LOCATIONS
CARRIER CORP., COLLIERVILLE, TN.

DATE: 9/6/89 | DWG NAME: CARR60

4.5.5 Selection and Preparation of Sample Containers

All sample containers supplied to EnSafe for the project will be precleaned by CompuChem Laboratories, Inc. in accordance with procedures specified in the CompuChem Standard Operating Procedures for Glassware Preparation referenced in Appendix E. All sample containers will be equipped with Teflon™ lined lids. The numbers and types of containers will be in accordance with CLP sampling procedures for TCL/TAL constituents and subsequent confirmed Site contaminants.

Sample Preservation

Samples to be analyzed for metals require that the samples be preserved in order to maintain their integrity. These samples will be preserved immediately upon collection in the field. Each sample preserved with chemicals will be clearly identified by indicating on the sample tag that the sample is preserved.

Sample Holding Times

Each individual laboratory analysis must be performed within a specified holding period from the time of sample collection. At the end of each sampling day all samples collected at the Collierville Site will be shipped overnight carrier (i.e. Federal Express) to CompuChem Laboratories for analysis to ensure that hlding times are met.

Sample Handling

After collection, samples will be handled as infrequently as possible. Extreme care will be taken to ensure that samples are not contaminated. All samples will be shipped utilyzing sample savers supplied by CompuChem Laboratories. These containers are designed to ensure maximum safety of the samples during transportation. As a final precaution, a trip blank will be prepared and kept with each set of samples and analyzed with the samples. If the trip blank analysis shows contamination, all results from that set of samples will be declared invalid and other representative samples will be collected.

4.6 Methodology

4.6.1 Monitoring Well Installations

Drilling techniques for the monitoring wells will also incorporate the use of hollow stem auger techniques. Depths of the wells will range between 30 and 55 feet.

None of the well installations will be placed in areas found to have high concentrations of contaminated soils during the initial borings. If significantly high levels of organic vapors are found the borehole will be abandoned and the drilling moved to another locations. This procedure will be done to protect the integrity of the well and to prevent cross contamination from the surface to the shallow aquifer.

Soil samples will be collected at 5.0 foot intervals using a standard 2-inch O.D. split-spoon sampling tool. Each sample will be classified in the field by an experienced geologist and the samples will then be placed in labeled glass jars. For each sample, the field geologist will also record indications of odor or visual contamination that may aid in future evaluation of data. The wells will be screened from the interface of the clay aquitard through the bottom 5 feet of the shallow aquifer unit, utilizing a 5-foot section of stainless screen. Previous investigations have shown this unit to contain less than 5 feet of water.

Stainless steel screen and riser will be incorporated to the first joint above the historic high water level, and galvanized riser will be used above that point. In addition, the threads of the joints seperating the stainless and galvanized riser will be wrapped with teflon tape to prevent bimetallic corrosion in the wells.

The screened section of each well will be backfilled with clean silica sand to approximately 2 feet above the top of the screen, sealed with at least 2 feet of granular bentonite, and backfilled to the surface with a cement/bentonite grout (Figure 9). To facilitate sampling procedures, new wells will have a minimum of 2.5 feet of stick-up. Each new well will be protected by a 4' x 4' x 6" concrete pad with an outward slope. A protective steel

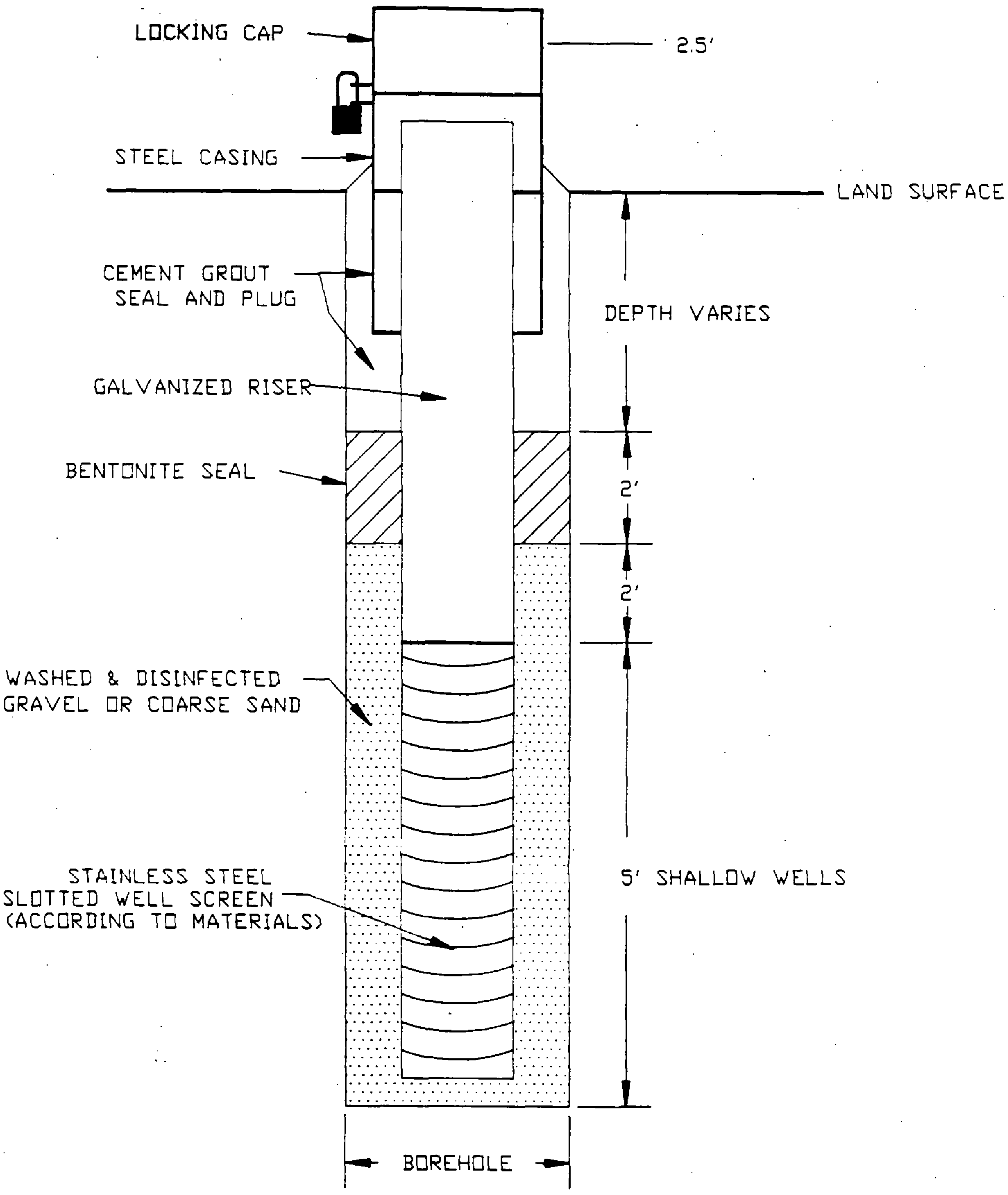

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FIGURE 9
SUGGESTED MONITORING
WELL SCHEMATIC

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casing will be installed at the surface with a locking cap for security. The top of each well casing will be surveyed to establish the elevation relative to datum used for the existing monitor wells, location and elevation relative to Site datum and existing wells. Water level elevations will be taken from a permanent notch in the casing, at the point surveyed.

After grout has set, the wells will be bailed and/or pumped to sufficiently develop the wells. Development procedures will continue until pH, temperature, and specific conductivity have stabilized. This methodology will be followed to determine if the wells are functioning properly and to obtain samples representative of the groundwater for analysis.

4.6.2 Well Abandonment

At the completion of the project when groundwater monitoring is no longer required, the monitoring wells will be taken out of service. For wells completed in the upper aquifer zone, the abandonment procedure will be to remove the well casings and screens by pulling them out of the ground with the use of a drill rig, a derrick, or a crane hoist. The resulting holes will be pumped full of neat cement grout containing approximately 10 percent bentonite on a dry weight basis. The grout will be pumped into the well bore using a rigid pipe placed at the bottom of the hole.

Wells completed in the lower aquifer zone will contain both relatively large conductor casings and standard 2-inch diameter riser pipes, both of which will be grouted into place. In consideration of these facts and the greater depth, it is unlikely that the deeper wells can be successfully pulled out of the ground. Therefore, the abandonment procedures for the deeper wells will be to remove the steel guard pipe, then cut both riser pile and the conductor pipe off approximately 1 foot below the ground surface. A cement and bentonite grout will then be injected at the bottom of each well until the riser pipe is completely sealed. The sealed wells may then be covered by topsoil, asphalt, or other material to complete reclamation of the well site.

All well-plugging and abandonment procedures will be supervised by a qualified geologist, experienced in well-plugging procedures. A plugging affidavit will be prepared to document the proper closure of each monitoring well. Well abandonment procedures are subject to the rules of the Memphis Shelby County Health Department.

4.7 Analytical Procedures and Quality Assurance

The Quality Assurance Project Plan will specify the analytical procedures for all sample media, as well as field and laboratory quality control. With regard to the contaminant of interest, extraordinary care is required in sampling and analysis in order to prevent loss of the contaminant due to volatilization.

In addition methodologies which yield lowest feasible limits of detection and quantification will be required. The Quality Assurance Program will establish these requirements and set up adequate field and laboratory controls to establish that the quality assurance objectives are being met.

All sampling activities will be conducted under rigid chain-of-custody procedures. These procedures will be discussed in more detail in the Quality Assurance Project Plan.

4.8 Health & Safety

The Site Sampling Program will be implemented only after preparation of a detailed Site Health & Safety Plan. While a preliminary review of Site data indicates that there will be no major health and safety constraints on the evaluation, the detailed Site Health and Safety Plan will address worker health and safety for each part of the study.

In particular, compliance with 29 CFR 1910.120, Occupational Safety and Health Standards for Hazardous Waste Operations and Emergency Response, will be required.

APPENDIX A

WESTON PROGRESS REPORT

WESTON

Roy F. Weston, Inc.
17 March 1986
W.O. No. 2640-01-01

CARRIER CORPORATION

Collierville, Tennessee Plant

PROGRESS REPORT

I. Background

Following heavy rains in late January 1985, a trichloroethylene (TCE) leak was detected near the southeast corner of the main production building at the Carrier facility in Collierville, Tennessee. TCE was found emanating from under an above ground, diked TCE storage tank pad and flowing into a nearby storm sewer. With immediate corrective action, Carrier recovered 542 gallons of TCE. The source of the leakage was later identified by Carrier Corporation as corroded distribution pipes which connected two of the tanks on the pad, installed in 1977 or 1978, to the main production building. Borings were drilled immediately after the spill into fill material (emplaced natural soil) that covered the upper four to six feet of the site. Lab results of soil samples indicated that the fill contained elevated TCE levels, thought to result from perching of water and contaminants on a permeability contrast between the fill and native silt/clay soils. The storage tank pad and distribution lines were removed in February 1985 along with a quantity of fill material.

Up to 15 feet of material was subsequently excavated by Carrier in the northeast corner of the affected area based on the results of a second series of borings. In May of 1985, soil samples from uncased borings in this excavated "pit" showed elevated levels of TCE down to the maximum boring penetration depth of 30 feet below original grade.

ROY F. WESTON, INC. (WESTON) was contracted by Carrier Corporation in June of 1985 to investigate and determine the extent of contamination and provide viable remedial options based on the results. A multi-phase program was initiated by WESTON.

Phase I

The WESTON Phase I study of TCE contamination at Carrier's Collierville, Tennessee site was completed in late July 1985. Phase I field activities included drilling of and sampling from 6 boreholes around the perimeter of the TCE release area and subsequent installation of lysimeters. Results and conclusions of the Phase I study included:

1. The site is underlain by 20 to 25 feet of unsaturated silts and clays overlying 20 to 25 feet of unsaturated sands in turn underlain by a minimum of 2 to 3 feet of low permeability (5×10^{-8} cm/sec), highly plastic clay (USCS classification CH).

2. Lab analyses of continuous soil samples from all 6 borings showed no trichloroethylene (TCE) above the detection limit of 1 ppm. These included samples from the top and bottom of Shelby tubes taken of the top of the confining clay.

Vapor wells (lysimeters) were installed in each borehole to monitor soil gas at the interface between the clay and overlying units in the event that the clay layer inhibited vertical movement of any contaminants. (Samples from the top of Shelby tubes showed the highest Organic Vapor Analyzer (OVA) head space readings.)

The clay layer was not penetrated during Phase I, since background data had indicated that groundwater in the Collierville area was frequently found under confined conditions beneath clay units at the same approximate depth of the clay unit near the pit. Logs of the two municipal supply wells, located approximately 2,000 feet northeast and at approximately the same elevation as the study area, showed in descending order 30 feet of clay, 20-25 of sand and gravel and 60 to 85 feet of clay and clayey sand above 180 to 190 feet of water bearing (Memphis Formation) sand.

Phase I results have been reported in detail in Reference A.

Phase II (through 23 October 1985)

The purpose of the Phase II study was to:

- Determine the potential for vertical migration of TCE into the first groundwater system located within or beneath the clay unit identified in Phase I.

- Obtain additional soil and water samples for laboratory analysis, to substantiate Phase I conclusions. In particular, place two additional borings, one inside the pit excavation to verify original contaminant levels; one within the main production building to "close the loop" of borings around the pit.

- Characterize groundwater (depth, quality, flow direction), by installation of four monitoring wells.

Three additional test borings/vapor wells were installed during the first stage of Phase II (see Figure 1 for all boring and well locations). The first, test boring 7 (TB #7), was drilled during the week of 14 October 1985 on the west side of the pit (through the foundation of the main manufacturing building) and completed the system of borings meant to encircle the pit. Borehole stratigraphy and lab results of soil samples from the borehole were similar to those of the previous 6 holes.

An attempt to place an all-terrain vehicle into the pit to obtain the second boring was unsuccessful, heavy rains having made the pit bottom unstable. As a result, it was decided to relocate this boring location to the pit perimeter. Two test borings (TB-8 and TB-1A) were subsequently accomplished on 19-20 November 1985 (refer to Section II of this report).

During the period 14 to 23 October 1985, an attempt was made to install groundwater monitoring wells at the site. The effort was curtailed prematurely due to cumulative problems with the drilling subcontractor; however, the boring for proposed monitoring well, MW-1, was advanced to 36 feet before termination of activities. Subsurface conditions in this hole were found to differ in several ways from the consistent pattern of silt-to-sand-to-clay in the vicinity of the pit. Alternating layers of unsaturated silt, clayey-silt, and sand characterize the upper 26 feet of MW-1. Even more significant, however, was that saturated conditions were encountered at a depth of approximately 29 feet within a sand and gravel zone.It was not known whether the encountered groundwater represented a perched system above the clay, flow within a channelized sand and gravel deposit incised into the clay or, in the absence of the clay unit, a local subcrop/recharge area of the groundwater system anticipated to be below the clay unit in the pit area.

Additionally, during the 14-23 October period, water samples of the untreated sprinkler water main, and a drinking fountain within the Carrier plant were obtained. Both measured less than detectable (<2.5 ppb) concentrations of TCE.

The Phase II data, through 23 October, were summarized in the Reference B report.

Following a subsequent review of these Phase II data, WESTON and Carrier decided that the Phase II effort should proceed as follows:

- The two test borings along the pit perimeter would be installed and sampled.
- Two wells would be installed at the MW-1 location to investigate both the shallow water bearing zone and the deep aquifer.
- Mud rotary drilling techniques (as opposed to hollow stem auger) would be used for well drilling.

II. Phase II Data and Results (after 23 October 1985)

The two additional perimeter test borings (TB-8 and TB-1A) were installed on 19-20 November 1985. TB-8 was located on the pit edge as close as possible to the area where initial Carrier sampling (May 1985) had identified elevated TCE levels below the pit (1850 ppm max). TB-1A was drilled less than 5 feet away from the location of TB-1 (which had to be backfilled during the initial WESTON drilling program due to overheating of augers). Stratigraphy in both TB-8 and TB-1A was again similar to that of earlier borings. However, laboratory results of soil samples showed TCE levels of 0.3 ppm (300 ppb) at two intervals within each boring. In both borings, the first interval (14.0 to 15.5 feet) corresponds

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to both the excavated bottom of the pit (then covered by 2 to 3 feet of silts and clays) and the change between predominantly brown and gray soils. The second interval differs in depth for the two borings, occurring at the sand-clay interface in TB-1A but 5 to 6 feet above the interface in TB-8. While 300 ppb TCE levels in TB-8 and 1A soils are high compared to the less than detectable levels in the other soil borings, the proximity of these soils to the area where TCE levels in May 1985 were measured at upwards of 1850 ppm suggests that either:

1. TCE levels are diminishing with time, following the removal of the contamination source by Carrier or,

2. The initial elevated TCE measurements were not indicative of concentrations below the pit, possibly being influenced by vertical migration of TCE during placement of the initial uncased boreholes.

All Phase II soil sample results are included in the Appendix to this report.

Following receipt of the November 1985 soil results, Carrier requested permission from the Tennessee Department of Health and Environment (DHE) to backfill the pit and restore elevations to grade level. The basis for this request was 1) absence of actionable levels of TCE in soil samples, 2) safety, and 3) to preclude further erosion and undermining of underground pipes in the area. Permission was granted by DHE on 20 November. The pit was backfilled shortly thereafter.

The additional Phase II effort was the installation of five monitoring wells to ascertain groundwater quality in the first drinking water aquifer beneath the Carrier facility. Well installation and development were completed during the period 2-11 December and 18-20 December 1985. Well data are shown in Tables 1 and 2, well locations in Figure 1. Water samples and water levels were obtained on 6-7 January and 20 February 1986. Water samples were analyzed for TCE by American Interplex Corporation in the former instance and by both American Interplex and WESTON in the latter instance.

Water samples were split with the Tennessee DHE on 7 January. All sample results are in Table 2 and 3. TCE levels above detection limits were measured in wells MW-4 and MW-1S; based on available data the source of the TCE cannot be determined.

Monitoring well water level measurements, taken on 6-7 January are also listed in Table 2. Based on these two sets of water level measurements, localized groundwater flow within the Memphis Sand aquifer is to the northwest in the direction of the municipal wells. It is not known, based on available data, if this is the natural flow direction or one induced by pumping of the municipal wells (a cone of influence from the municipal wells is possible but is yet undefined).

The presence of saturated conditions above the traditional elevation of the clay in boring MW-1, drilled at a location between the plant and a nearby municipal water supply well, dictated that two wells be set into this area, one into a shallow perched water system and the second into the underlying Memphis sand. An outer casing set and grout sealed 3 to 5 feet into the top of the clay circumvented any possibility of cross-contamination between water-bearing systems. This type of an outer casing was subsequently used in the construction of all deep wells to protect the lower aquifer even though no perched conditions were reported in the other three borings.

The presence of the perched water system in MW-1S was only one of several indications of the confining ability of the clay unit. As shown in Table 1, in monitoring well 1 deep (MW-1D) the top of the clay was penetrated at 36 feet while the first water bearing sand was reported at 90 feet. Static water level in the finished well following development was approximately 57 feet below grade, a level within the unsaturated confines of the clay unit. The confining/retarding ability of the clay at MW-1S/1D is further supported by the absence of TCE in the single MW-1D groundwater sample (whereas groundwater from shallow monitoring well MW-1S contained 21 to 50 ppb TCE).

The clay unit thins to the southeast (the top dips while the bottom rises slightly in the southeast direction). Perhaps more important is the finding that the clay unit also becomes progressively sandier to the south and southeast, possible limiting both its confining ability and its potential effect as a barrier to contaminant migration.

Predicting the movement (if any) of residual TCE away from the pit area is difficult. TCE tied up in soils beneath the pit area may possibly be released by infiltration and migrate down to and along the natural permeability contrast between the clay and overlying sand (which slopes to the south and southwest) and then vertically into the deeper Memphis aquifer through the sandy clay/clayey sand areas. However, data are insufficient to confirm this.

III. <u>Summary of Results and Observations</u>

1. Measured TCE levels in soil immediately adjacent to the pit excavation do not exceed 300 ppb.

2. Based on a limited number of monitoring well level measurements, localized groundwater flow in the area of the Carrier Corporation is to the northwest in the direction of the municipal drinking water supply well. It is not known if this is a natural flow direction or one induced by the pumping of the municipal well field.

3. A TCE contaminated, perched water system of unknown size and character exists northwest of the main production building near monitoring wells MW-1S and MW-1D. Measured TCE levels ranged from 21 to 50 ppb. The analyte does not presently appear in the drinking water aquifer immediately below at or above the detection limit of 2.5 ppb.

4. The trace levels of TCE measured in the drinking water aquifer at MW-4 could result from low-level TCE release from soils under the pit area (migrating vertically to the top of clay and travelling along the clay interface

TABLE 1

WELL DATA AND WATER LEVELS (6-7 January 1986)

Well No.	Top of Clay (ft) BGS	Top of Memphis Sand (ft) BGS	Static Water Level (ft) BGS
MW-1D	~36'	90'	57.23
MW-2D	50'	85'	57.66
MW-3	54.5	75'	56.59
MW-4	~ 53	75-80'	56.59

BGS - below ground surface

TABLE 2

MONITORING WELL WATER LEVEL AND TCE DATA (6-7 January 1986)

Well	Elevation (MSL)[1] TSU[2]	Stick-Up Length (ft)	Total Depth (ft) TSU	Water Level (ft) TSU	Water Level Elevation (MSL[3]) TSU	TCE in ppb[4]
MW-1D	343.20	2.25	110.55	59.19	284.01	< 2.5
MW-1S	343.03	2.40	33.66	30.2	312.87	21.0
MW-2D	344.84	2.15	105.15	59.78	285.06	< 2.5
MW-3	344.03	2.10	90.27	58.26	285.77	< 2.5
MW-4	343.91	----	107	58.1	285.81	9.4

1. Elevation data for monitoring wells was obtained and provided by Carrier Corporation. Data are included in Appendix B.

2. TSU is Top of stick-up

3. MSL is mean sea level

4. Analysis performed by American Interplex Corporation (Memphis, TN). TCE analyses of split samples by Tennessee DHE show 20 ppb for MW-15 and 12 ppb for MW-4; other results less than detectable.

TABLE 3

MONITORING WELL TCE DATA (20 February 1986)[1]

Well	TCE in ppb (analysis by American Interplex)	TCE in ppb (analysis by WESTON)
MW-1D	<2	<1
MW-1S	<2	50
MW-4	<2	<1[2]

---

1 Samples obtained by ENSAFE (Memphis, TN).

2 Duplicate sample measured 1.1 ppb.

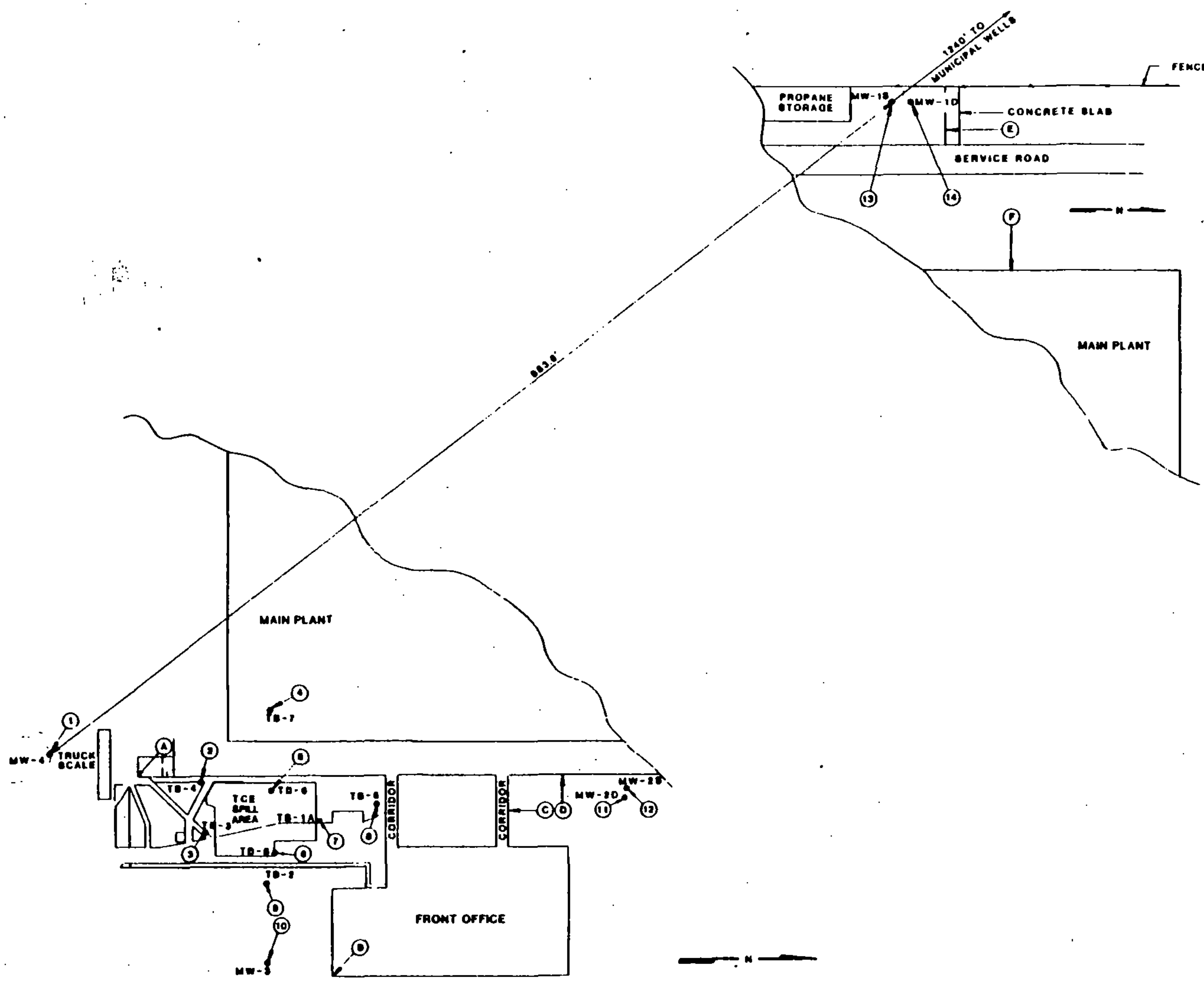
toward MW-4). However, data are not sufficient to confirm this hypothesis.

5. The public water system is not presently being affected by TCE.

IV. References

A. Progress Report by Roy F. Weston, Inc., 19 September 1985.

B. Progress Report by Roy F. Weston, Inc., 11 November 1985.



NOTE:
NUMBERS 1 THROUGH 14 ARE KEYED TO ELEVATION SURVEY (REFER TO APPENDIX B)

CARRIER CORPORATION

COLLIERVILLE TENNESSEE

WESTON

WELL LOCATIONS

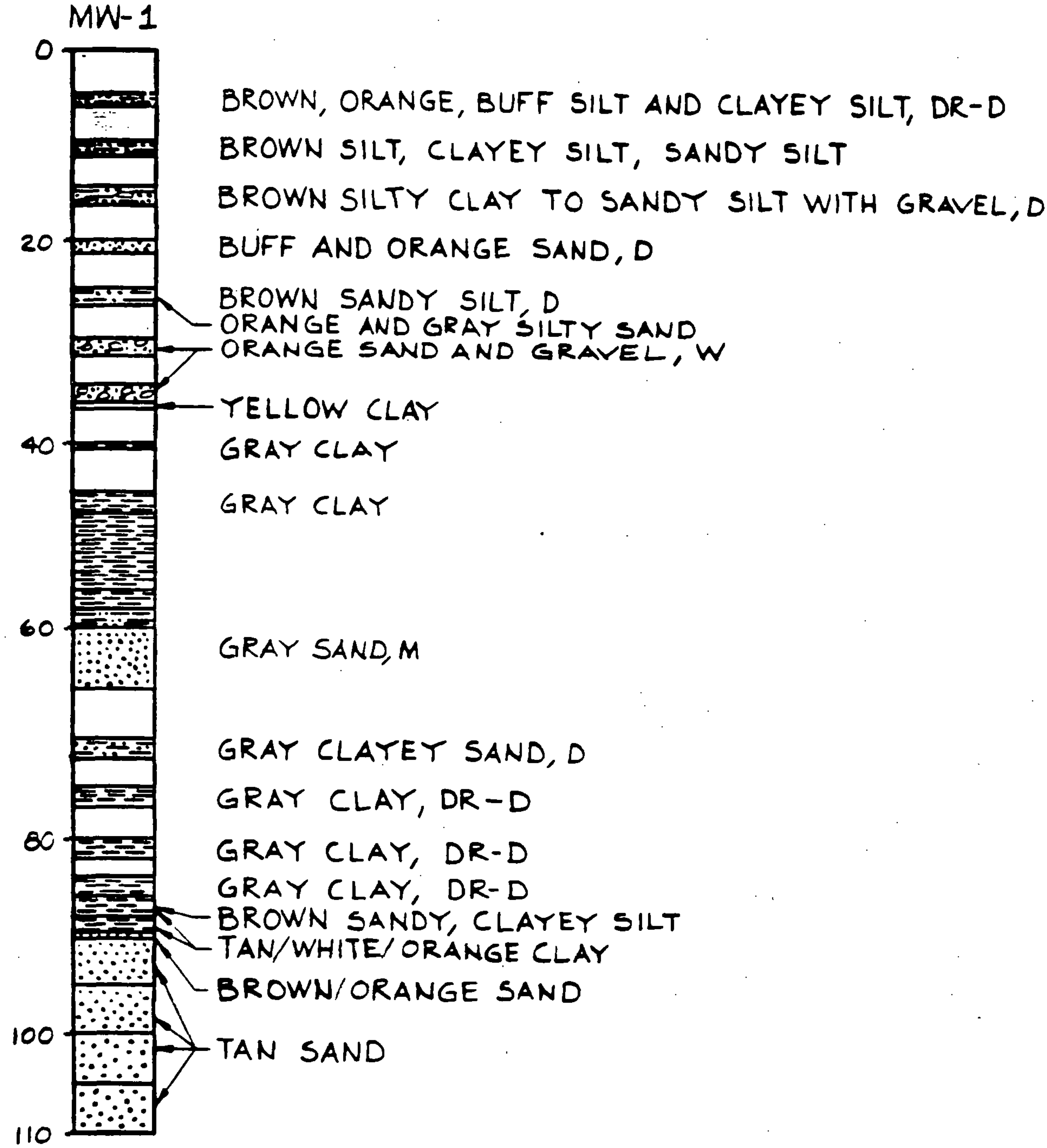
DRAWN LRM | SCALE NONE | 2840-01-01

FIG. 1

WESTON

APPENDIX A

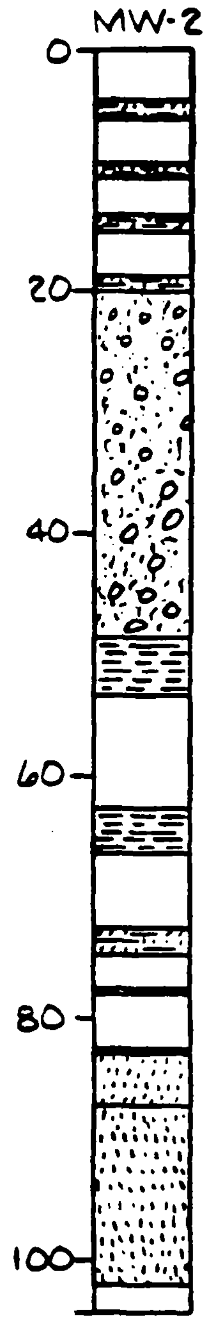
Phase II Soil Boring Logs



DR - DRY
D - DAMP
M - MOIST
W - WET

1/4" = 4'

MONITORING WELL-1 BORING LOG	ROY F. WESTON, INC. WESTON ENVIRONMENTAL CONSULTANTS-DESIGNERS				
	DRAWN LRM	DATE 2-13-86	DES. ENG.	DATE	W. O. NO.
	CHECKED		APPROVED		DWG. NO.



BROWN/GRAY CLAYEY SILT, D

GRAY/TAN CLAYEY SILT, D

BROWN/GRAY SILTY CLAY MOTTLED, DR-D

BROWN SILTY SAND, D

BROWN SAND & GRAVEL, W

MAROON/YELLOW/WHITE CLAY, D

TAN/ORANGE SANDY, SILTY CLAY, D

ORANGE SILTY SAND & GRAY/ORANGE CLAY

ORANGE CLAYEY SAND

BROWN SAND

1/4" = 4'

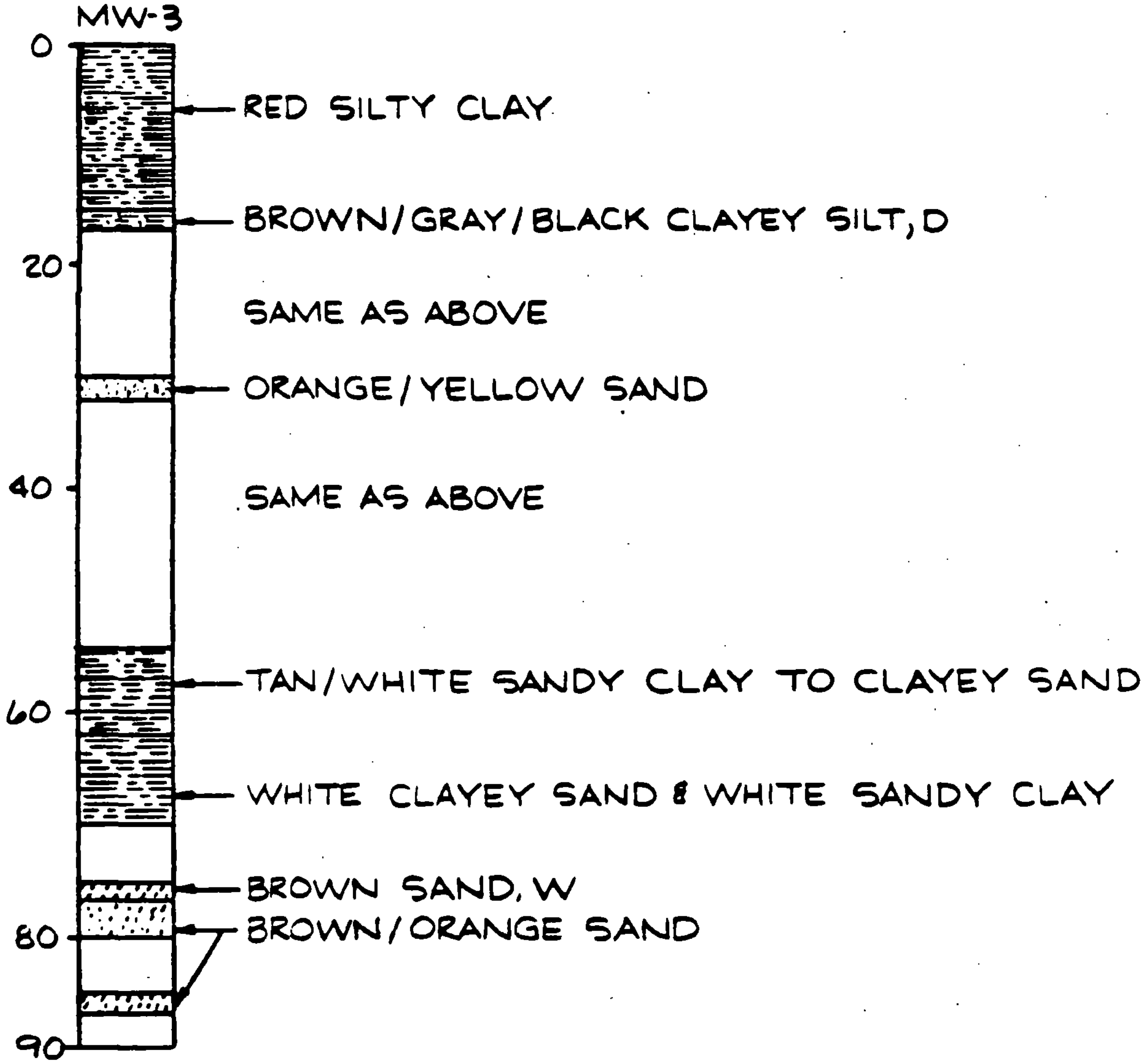
DR-DRY
D-DAMP
M-MOIST
W-WET

MONITORING WELL-2

BORING LOG

ROY F. WESTON, INC.
WESTON
ENVIRONMENTAL CONSULTANTS-DESIGNERS

DRAWN B.B.B	DATE 2-13-86	DES. ENG.	DATE	W. O. NO.
CHECKED		APPROVED		DWG. NO.



1/4" = 4'

D - DAMP
W - WET

MONITORING WELL-3 BORING LOG	ROY F. WESTON, INC. WESTON ENVIRONMENTAL CONSULTANTS-DESIGNERS				
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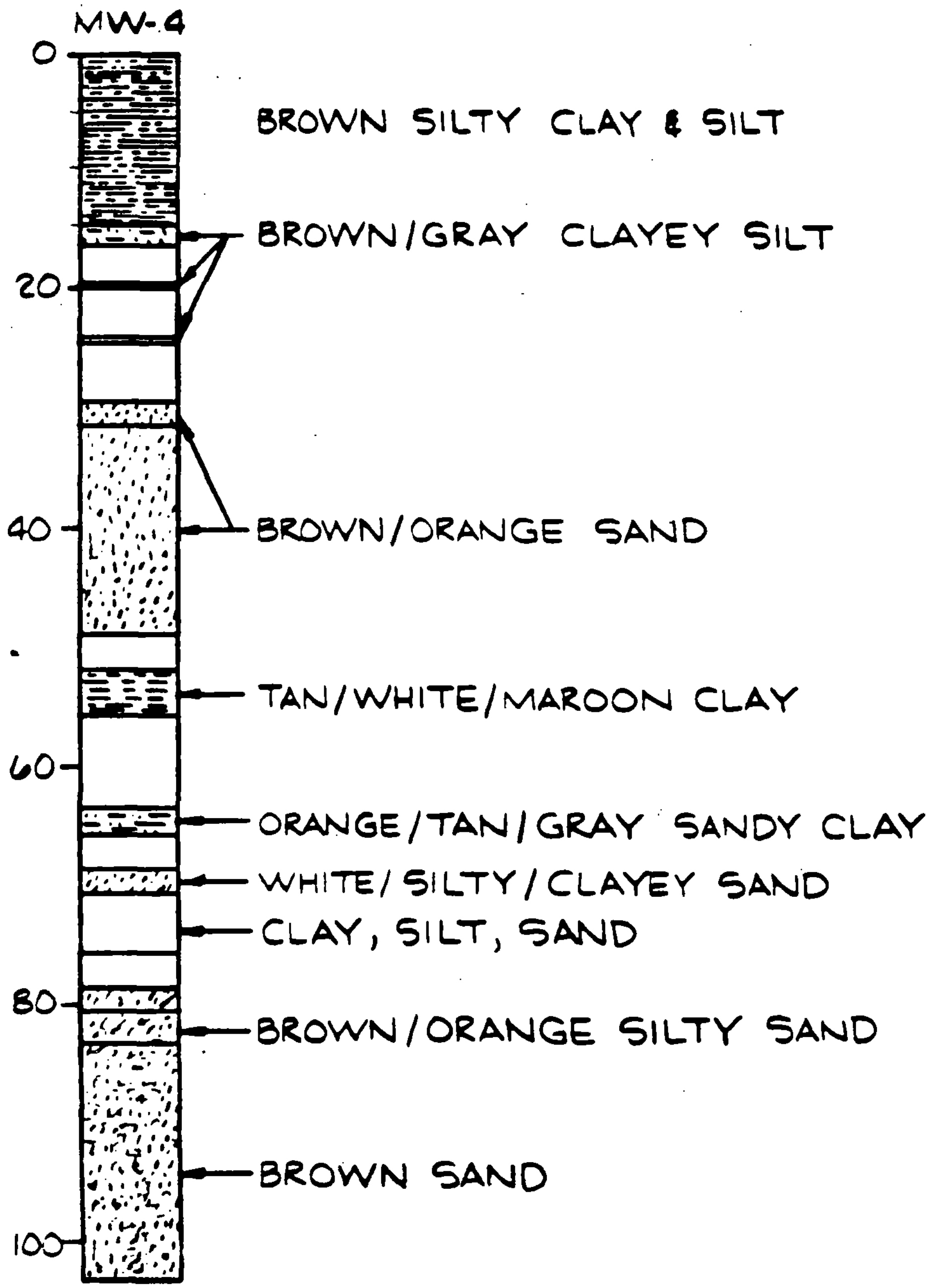
	CHECKED		APPROVED		DWG. NO.



1/4" = 4'

MONITORING WELL-4

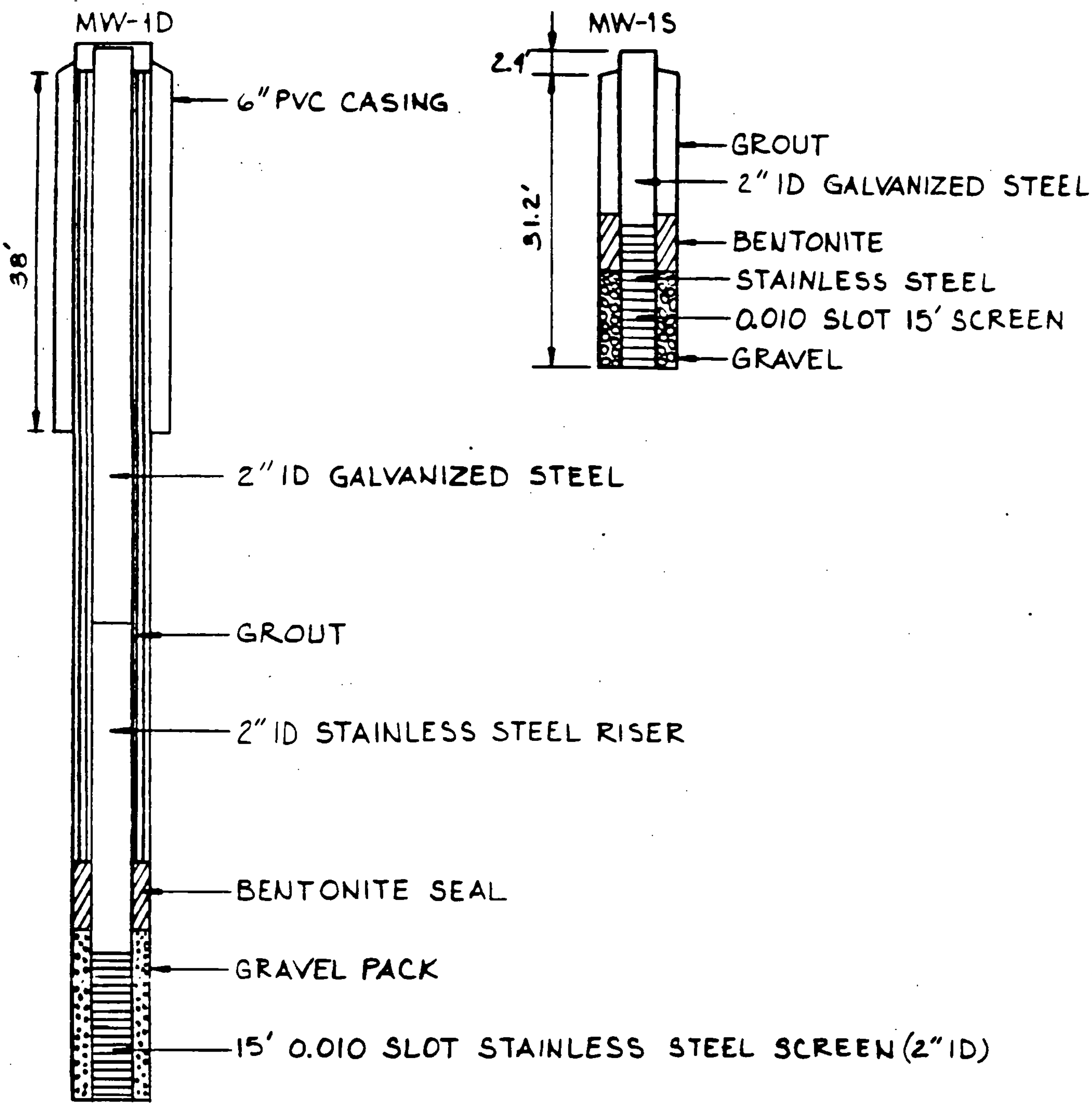
BORING LOG

ROY F. WESTON, INC.

WESTON

ENVIRONMENTAL CONSULTANTS-DESIGNERS

DRAWN	DATE	DES. ENG.	DATE	W. O. NO.
BBB	2-13-86			
CHECKED		APPROVED		DWG. NO.

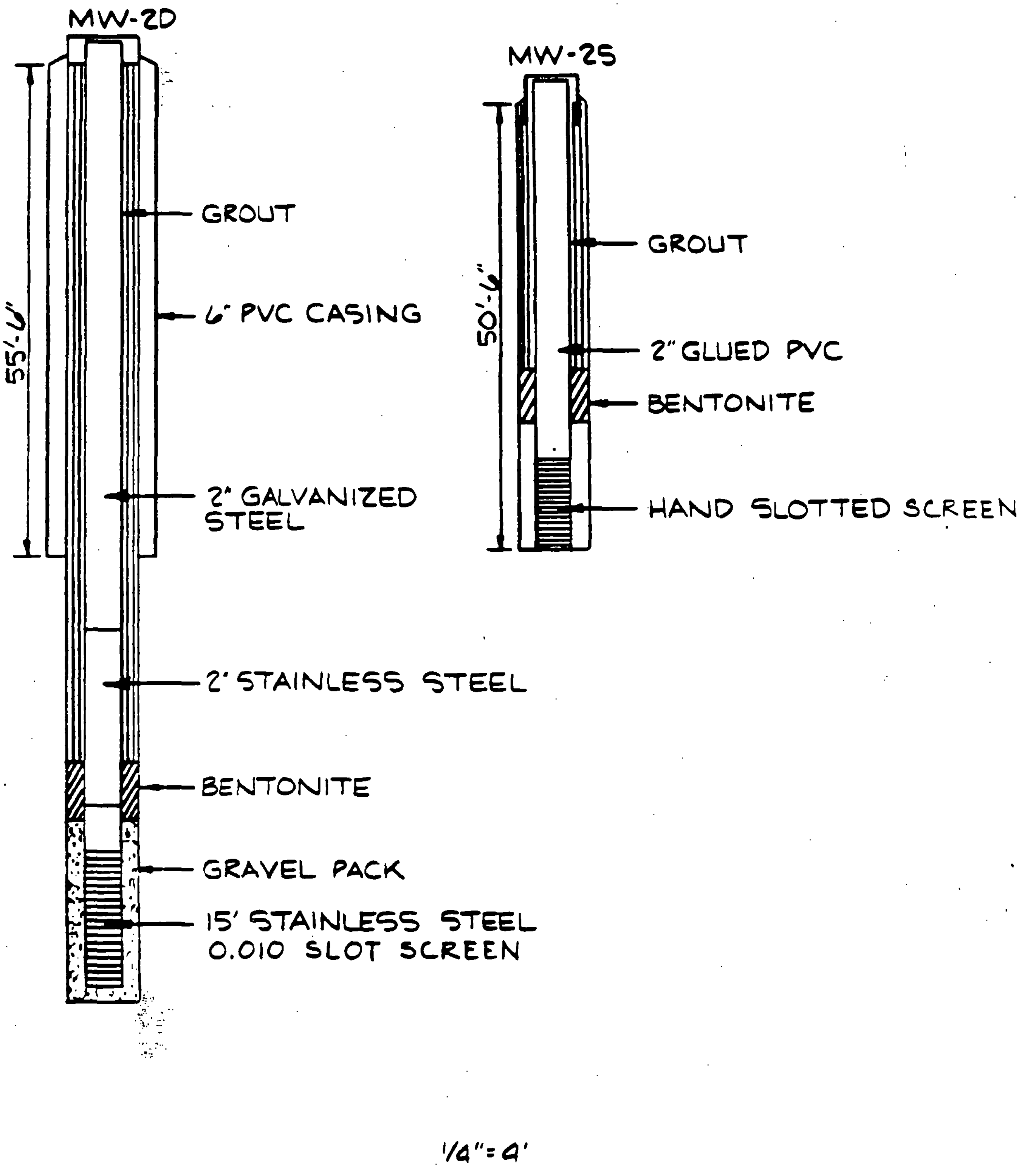


DR - DRY
D - DAMP
M - MOIST
W - WET

MONITORING WELL
1D & 1S
CONSTRUCTION
DETAILS

ROY F. WESTON, INC.
WESTON
ENVIRONMENTAL CONSULTANTS-DESIGNERS

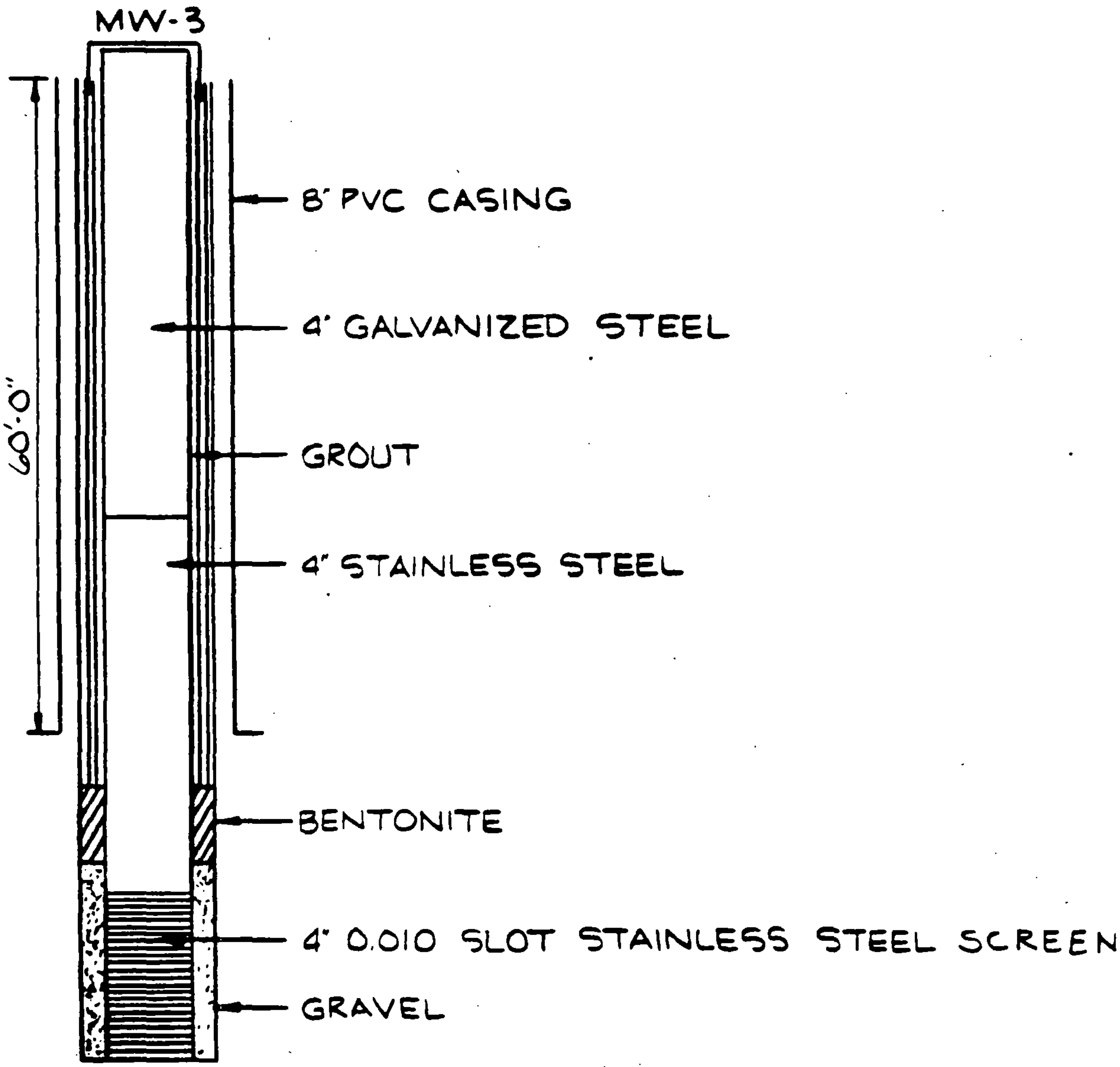
DRAWN LRM	DATE 2-14-86	DES. ENG.	DATE	W. O. NO.
CHECKED		APPROVED		DWG. NO.



MONITORING WELL
2D & 2S
CONSTRUCTION
DETAILS

ROY F. WESTON, INC.
WESTON
ENVIRONMENTAL CONSULTANTS-DESIGNERS

DRAWN	DATE	DES. ENG.	DATE	W. O. NO.
BBB.	2-13-86			
CHECKED		APPROVED		DWG. NO.



1/4" = 4'

MONITORING WELL-3

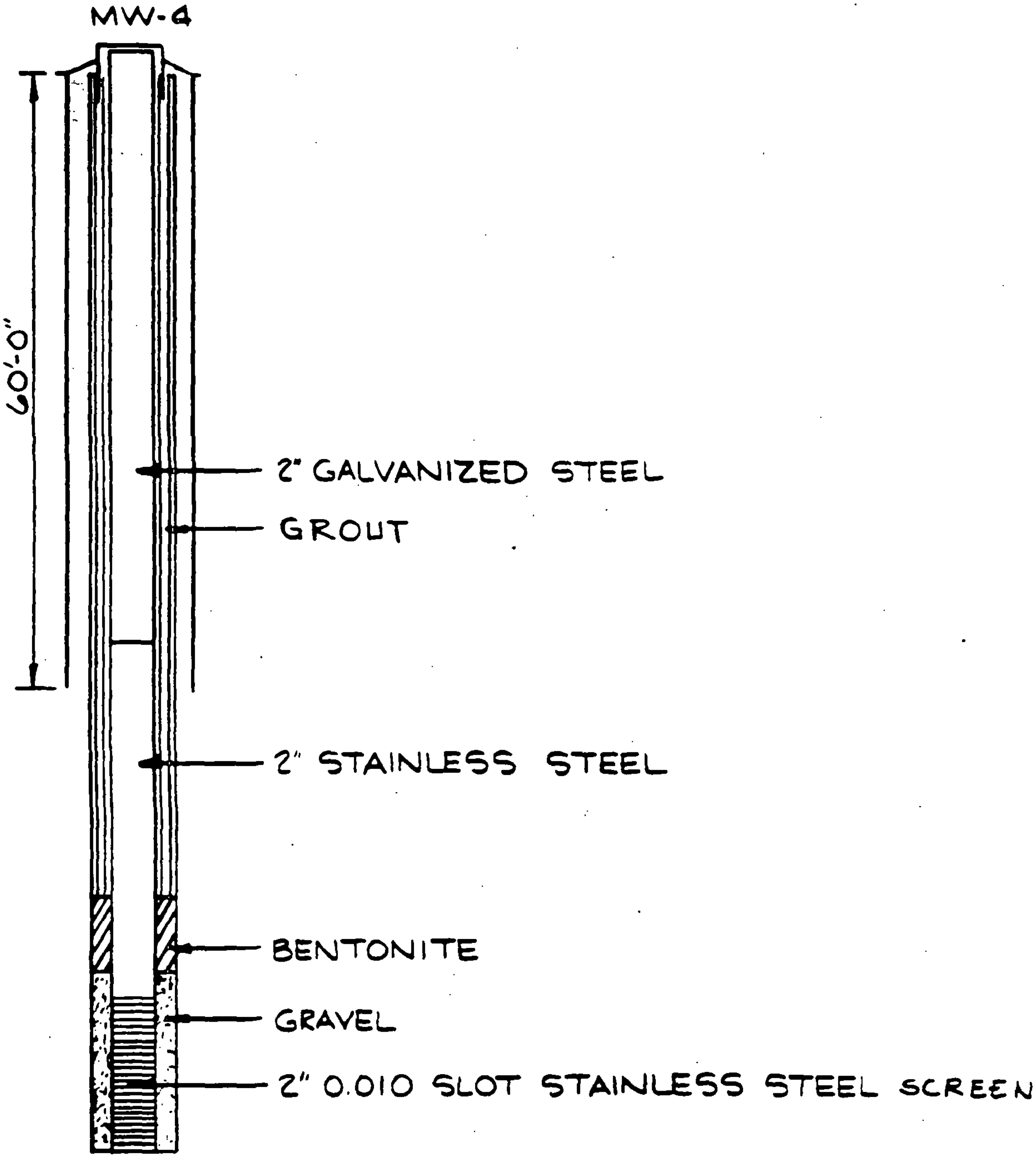
CONSTRUCTION DETAILS

ROY F. WESTON, INC.

WESTON

ENVIRONMENTAL CONSULTANTS-DESIGNERS

DRAWN	DATE	DES. ENG.	DATE	W. O. NO.
BBB	2-12-86			
CHECKED		APPROVED		DWG. NO.



1/4" = 4'

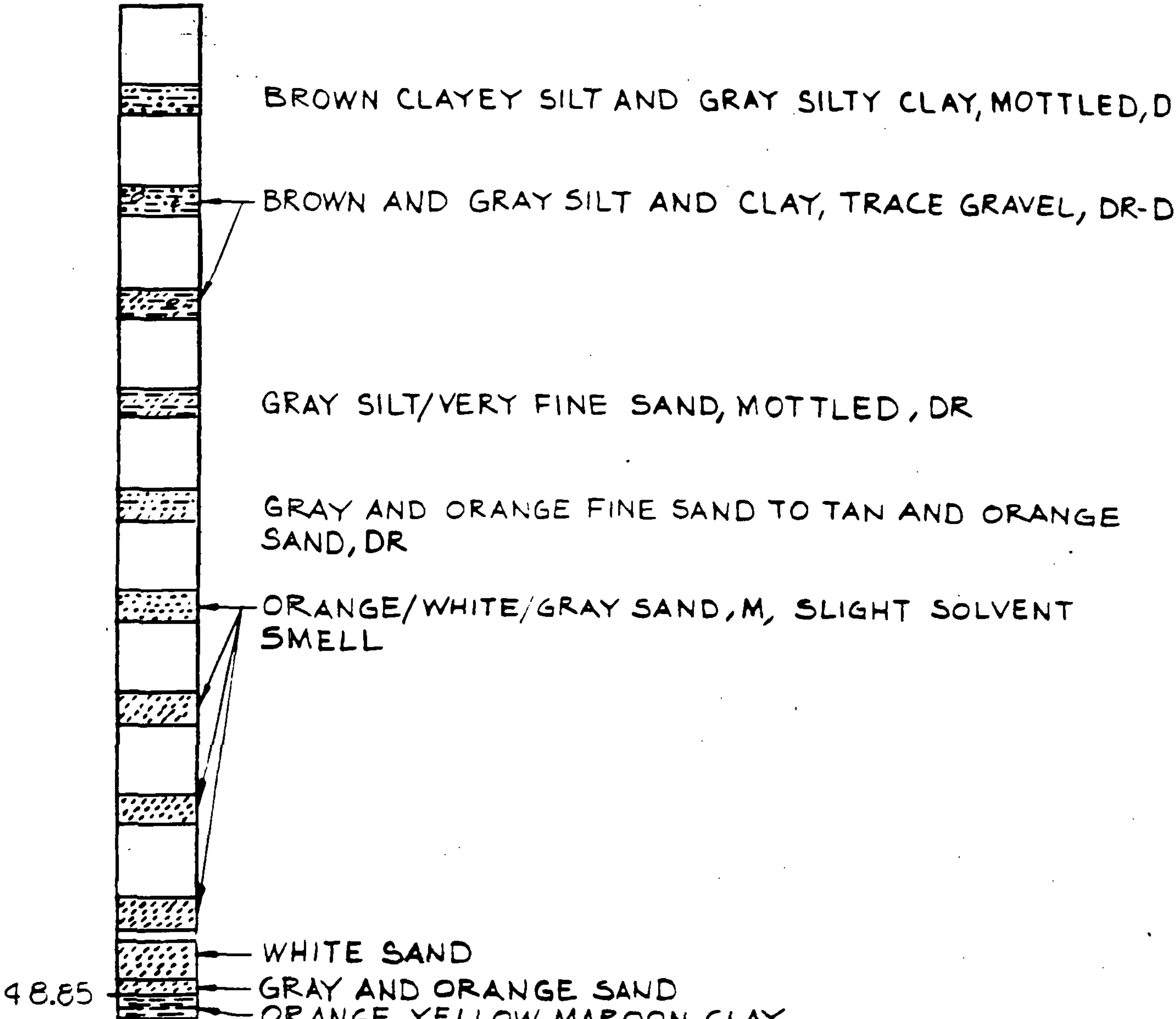
MONITORING WELL-4

CONSTRUCTION DETAILS

ROY F. WESTON, INC.
WESTON
ENVIRONMENTAL CONSULTANTS-DESIGNERS

DRAWN	DATE	DES. ENG.	DATE	W. O. NO.
BBB	2-13-86			
CHECKED		APPROVED		DWG. NO.

TB-1A



DR - DRY
D - DAMP
M - MOIST

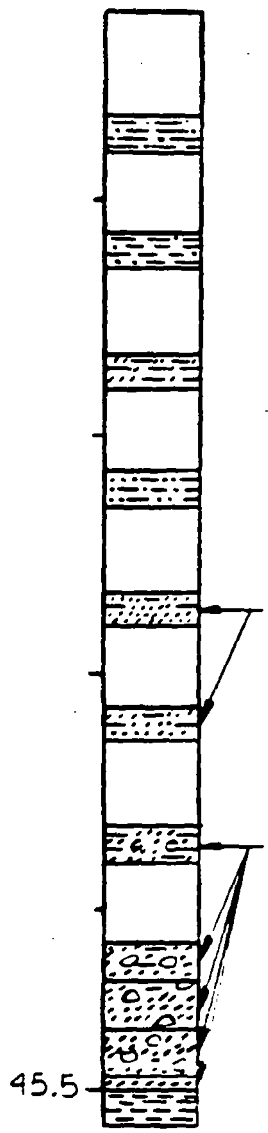
1/8" = 1'

TEST BORING
- 1A -

ROY F. WESTON, INC.
WESTON
ENVIRONMENTAL CONSULTANTS-DESIGNERS

DRAWN LRM	DATE 2-14-86	DES. ENG.	DATE	W. O. NO.
CHECKED		APPROVED		DWG. NO.

TB-7



BROWN/GRAY SILT- CLAYEY SILT, MOTTLED, D

BROWN/GRAY, SILTY CLAY, DR

LIGHT BROWN CLAYEY SILT, DR

BUFF SILT, SOME CLAY, DR-D

TOP-ORANGE SILTY SAND, D-M
BOTTOM WHITE/BUFF SAND

ORANGE AND WHITE SAND, D-M

YELLOW/BUFF CLAY, M

DR - DRY
D - DAMP
M - MOIST

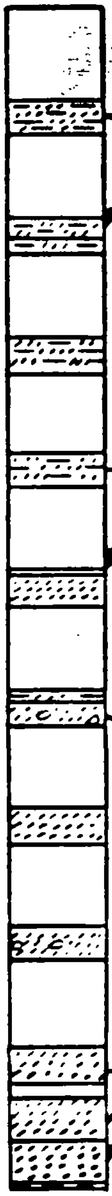
1/8" = 1'

TEST BORING
\- 7 -

ROY F. WESTON, INC.
WESTON
ENVIRONMENTAL CONSULTANTS-DESIGNERS

DRAWN LRM	DATE 2-14-86	DES. ENG.	DATE	W. O. NO.
CHECKED		APPROVED		DWG. NO.

TB-8



GRAY CLAYEY SILT, D

BROWN CLAYEY SILT TO SILT AND CLAY, DR-D

SAME AS 5.0-5.5

GRAY SILT, LITTLE CLAY, MOTTLED, DR

BUFF TO BROWN SILTY SAND, LITTLE GRAVEL, DR

GRAY SILTY CLAY, DR
ORANGE/WHITE SAND, TRACE GRAVEL, DR-D

ORANGE/WHITE MEDIUM GR. SAND, LITTLE GRAVEL
D

ORANGE SAND, TRACE GRAVEL, D-M

ORANGE AND WHITE SAND

ORANGE AND WHITE CLAY

DR - DRY
D - DAMP
M - MOIST

1/8" = 1'

TEST BORING -8-	ROY F. WESTON, INC. WESTON ENVIRONMENTAL CONSULTANTS-DESIGNERS				
	DRAWN LRM	DATE 2-14-86	DES. ENG.	DATE	W. O. NO.
	CHECKED		APPROVED		DWG. NO.

WESTON

APPENDIX B

Monitor Well Survey and Elevation Data

UNITED TECHNOLOGIES CARRIER

Carrier Corporation
97 South Byhalia Road
Collierville, Tennessee 38017
(901) 853-9761

January 15, 1986

"PROJECT MGMT"
JAN 27 1986

Mr. Don Messenger
Roy F. Weston Inc.
Weston Way
West Chester, Pennsylvania 19380

Re: Monitoring Well Location and Elevation Report, Site Plan; attached.

Gentlemen:

Enclosed please find the monitoring well information you requested. The following notes should help clarify this report:

- wells for this report have been numbered from 1 through 14, South to North respectively from their reference points,
- wells which reach into ground water are designated by GW,
- wells which do not reach ground water are designated by MW,
- Reference Point A is the Southeast corner of the main plant,
- Reference Point B is the Southeast corner of the front office building,
- Reference Point C is the North edge of the North corridor concrete slab,
- Reference Point D is the East edge of the main plant floor,
- Reference Point E is the South edge of concrete slab North of the propane storage tank,
- Reference Point F is the West edge of main plant floor,
- location measurements were taken perpendicular from the plane of the Reference Points to the center-line of the well,
- elevations are measured to the top of the well covers, and
- the benchmark for elevations is our main plant floor elevation established at 343.00 feet above sea level.

Please advise if additional information is required.

Copy to:
Gerald Bailey
John Brewer
Bradford Cushing
Jim Kelly

Respectively,

Edgar Smith

CLV-7